# Module 4: Dynamic Macroeconomic Models in Regulatory Impact Assessments (RIA)

- Advantages and Challenges of Using Dynamic Macroeconomic Models
- Background on Dynamic Macroeconomic Models
- Class Exercise 1:  Using a Macroeconomic Model
- Class Exercise 2:  Using a Macroeconomic Model

# As part of this module you will ….

- Learn how dynamic macroeconomic models can supplement input - output models as part of  a cost / benefit analysis framework
- Learn about alternative types of dynamic macroeconomic models, their components and what makes them useful for regulatory assessments
- Gain experience operating dynamic macroeconomic models using modeling software as you work through two case studies

# Advantages and Challenges of Using Dynamic Macroeconomic Models

# Dynamic macroeconomic models can supplement input-output analysis by estimating the same comprehensive effects over time

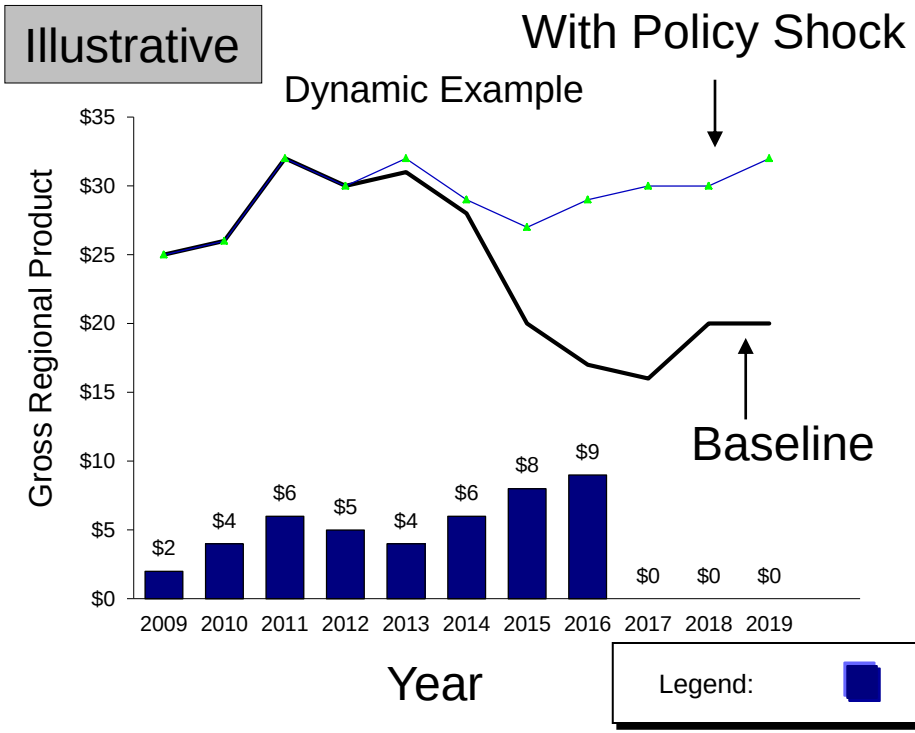
- Cost benefit analyses can only address impacts that are quantifiable in terms of some monetary value
  - Thus can obviously only address ***known*** impacts which tends to ignore secondary and tertiary impacts
- Input-output analyses are able to augment these known impacts to capture more comprehensive effects
  - Direct impacts
  - Indirect impacts
  - Induced impacts
- **Dynamic macroeconomic models also augment impacts to capture comprehensive effects, but are more accurate as they do so over time and allow analysts to think through the less obvious interconnections associated with a regulatory change**

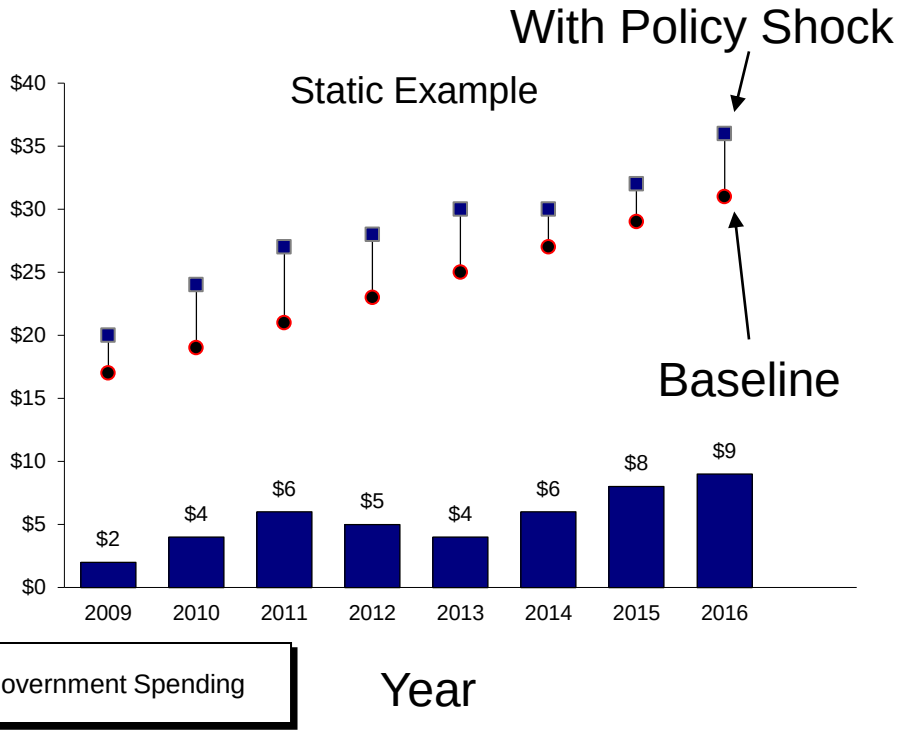
# Where I-O tables are static, dynamic macroeconomic models can capture the dynamic effects over time

**Macroeconomic models capture the dynamic effects for each year in the future:**
- Forecast shows fluctuations based on assumptions built into the model
- Continues the forecast even after injects end

**A static analysis using an I-O provides a partial picture:**
- Will result in a linear trend line if no further assumptions are made
- Forecast becomes less dependable as you move further out in time

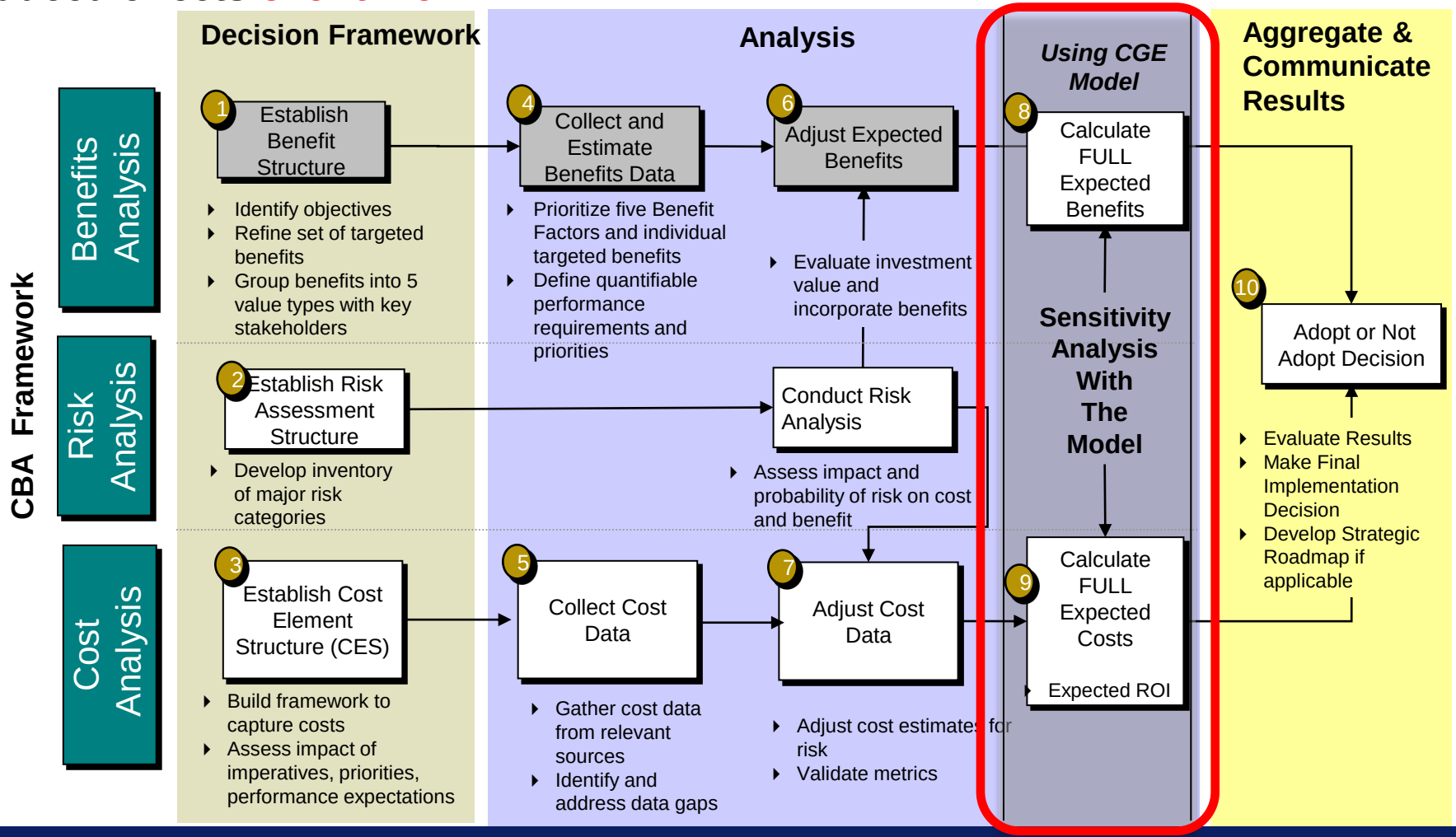
Illustrative



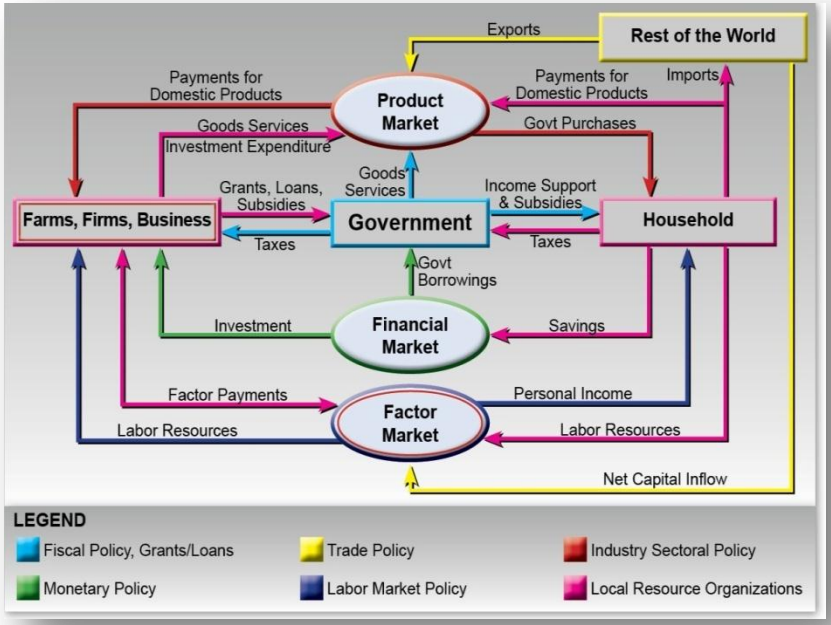

Legend: Government Spending

# To improve the accuracy of the assessment, the cost benefit analysis portion of RIAs should be expanded to include costs and benefits with direct, indirect and induced effects over time



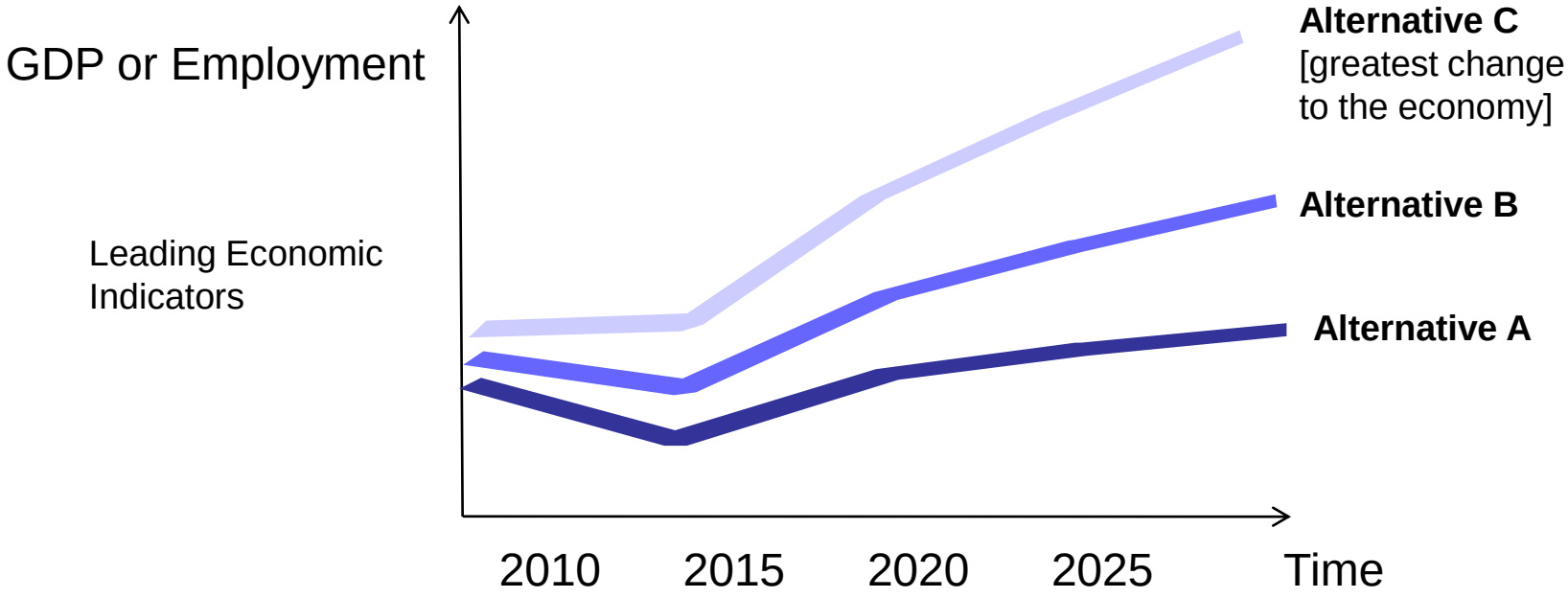
- **One can perform RIAs using large dynamic forecasting models to help assess:**
  - Distribution of income (Gini coefficient)
  - Degree of price fixing vs. market economy
  - Availability of essential public services
  - Access to education/employment
  - Size of government bureaucracy
  - Degree of regulation
  - Job creation
  - Size and financing of government debt (public finance management)
  - Monetary/banking/financial infrastructure
  - Agricultural development
  - Condition of physical infrastructure

- **Are more comprehensive in approach**
- **Allow for dynamic change**
- **Can account for hundreds of variables changing simultaneously**

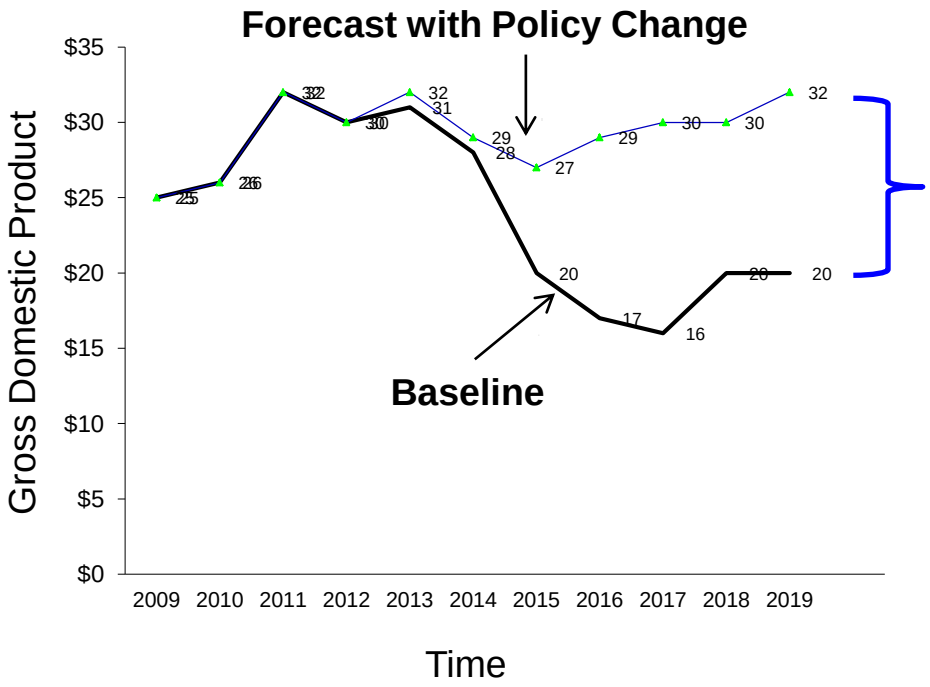


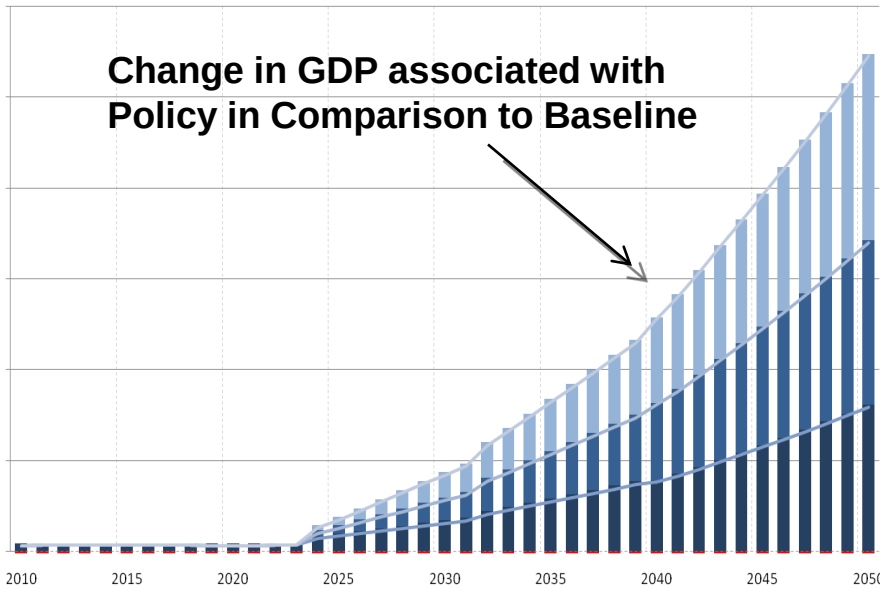

- A regulatory impact assessment should take into account the many components of an economy that work together as an integrated whole
- To more accurately measure changes to economic indicators, we measure direct, indirect and induced effects using state-of-the-art econometric models

# The flexibility of these models allows us to explore various alternative policy options, regulations, and spending options

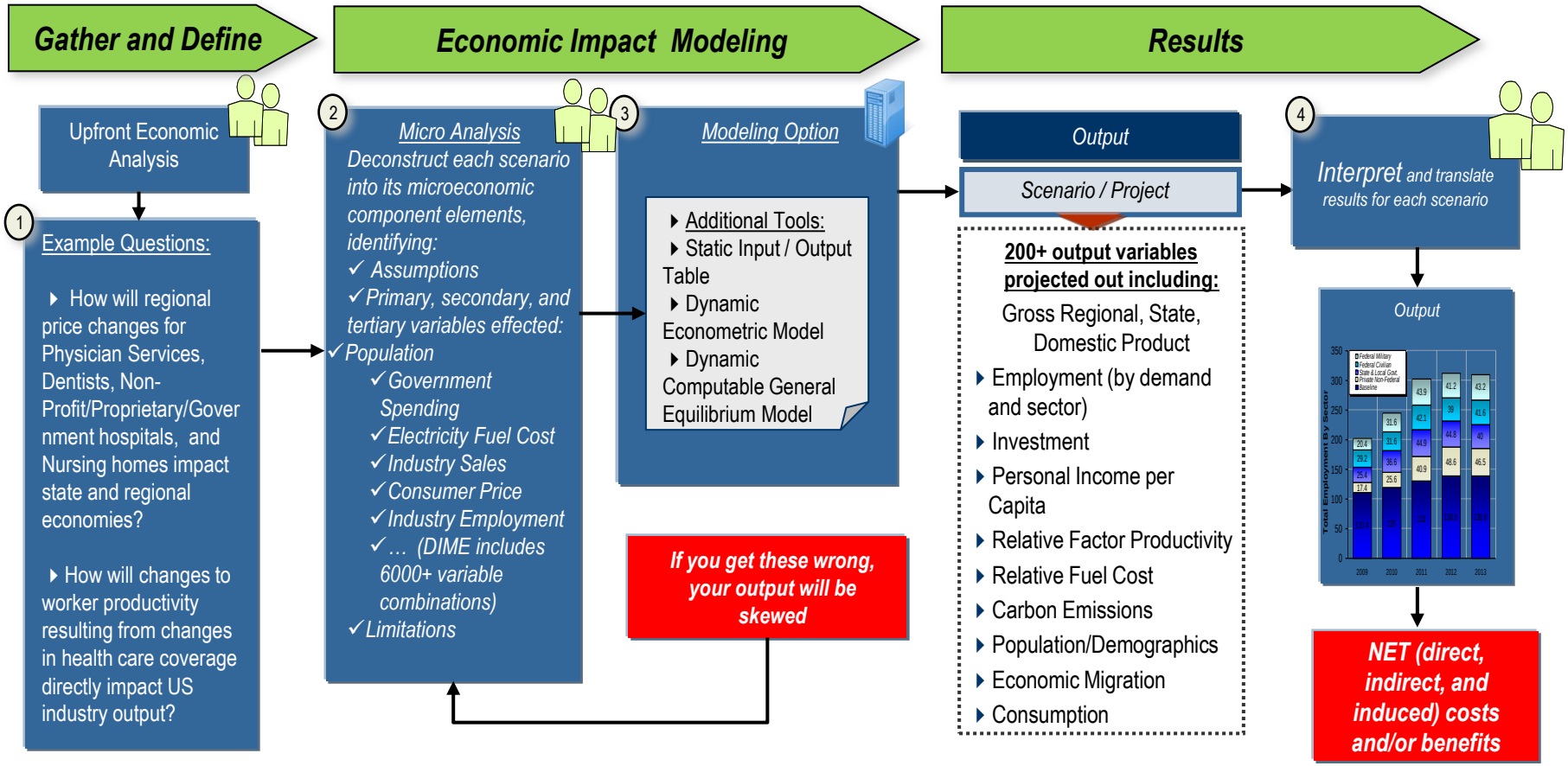


# Allow us to measure the relative change between the "baseline" picture of the economy and the policy, regulation, etc. change we are measuring



# Garbage In – Garbage Out : Process workflow of using these models means that using the wrong assumptions can easily skew results



# Background on Dynamic Macroeconomic Models

# Alternative types of dynamic forecasting econometric models

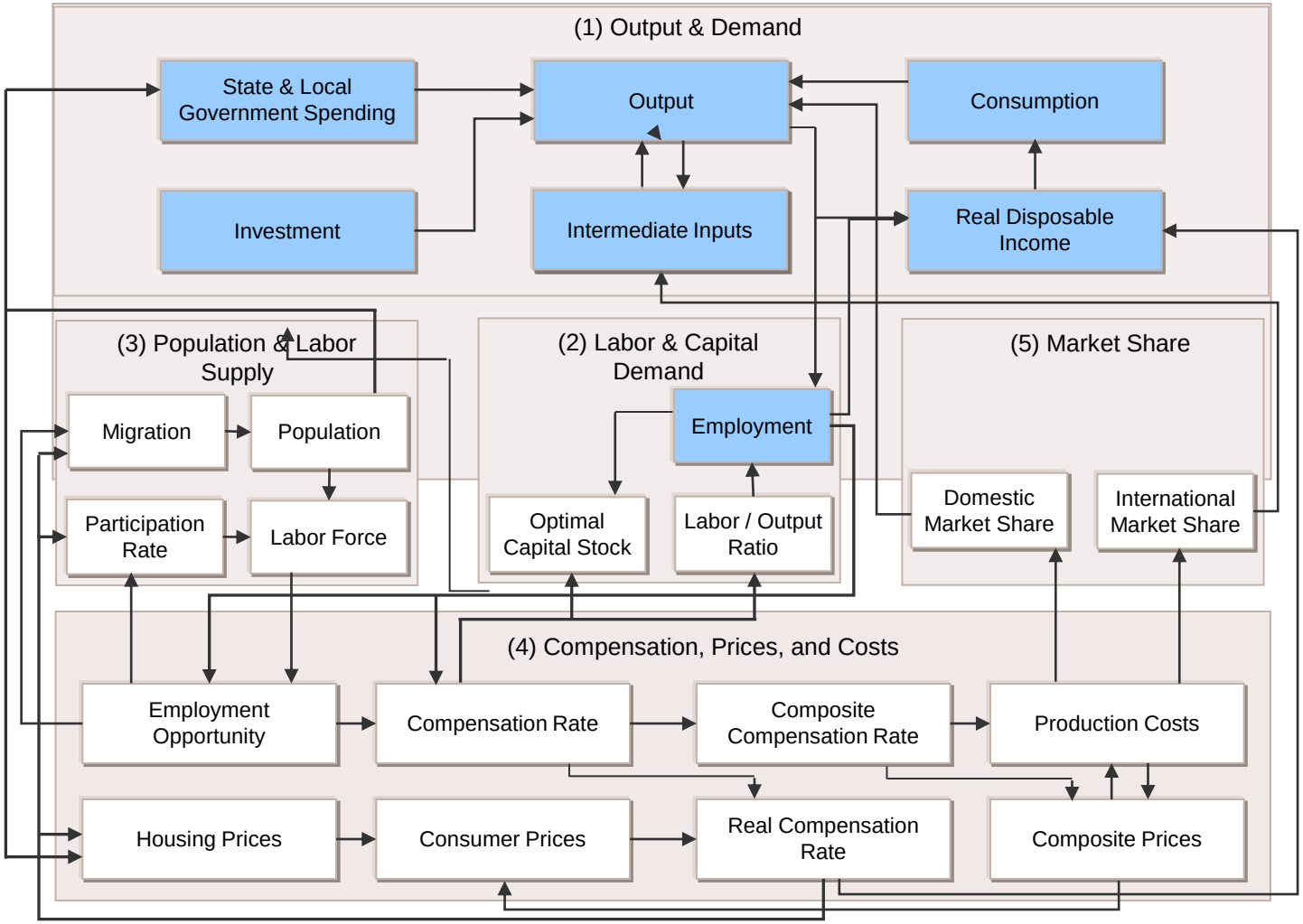
- **Simple Econometric Models measure past relationships among** such **variables** as consumer spending, household income, tax rates, interest rates, employment, etc. and then forecast how changes in some variables will affect the future course of others
  - Simple example: Assumes that monthly spending by consumers is linearly dependent on consumers' income in the previous month. Then the model will consist of the equation where Ct is consumer spending in month t, Yt-1 is income during the previous month, and et is an error term measuring the extent to which the model cannot fully explain consumption

$$C_t = a + bY_{t-1} + e_t,$$

- **Dynamic Econometric Model** is a **system of equations** describing the behavior of the economic agents, the structure of the markets and the institutions, and the links between them, one solution to which is believed to be known from the observed (historical) data

- **Computable general equilibrium (CGE)** models take the econometric equations within an Econometric model and allow for the coefficients to change based on economic theory and market mechanisms

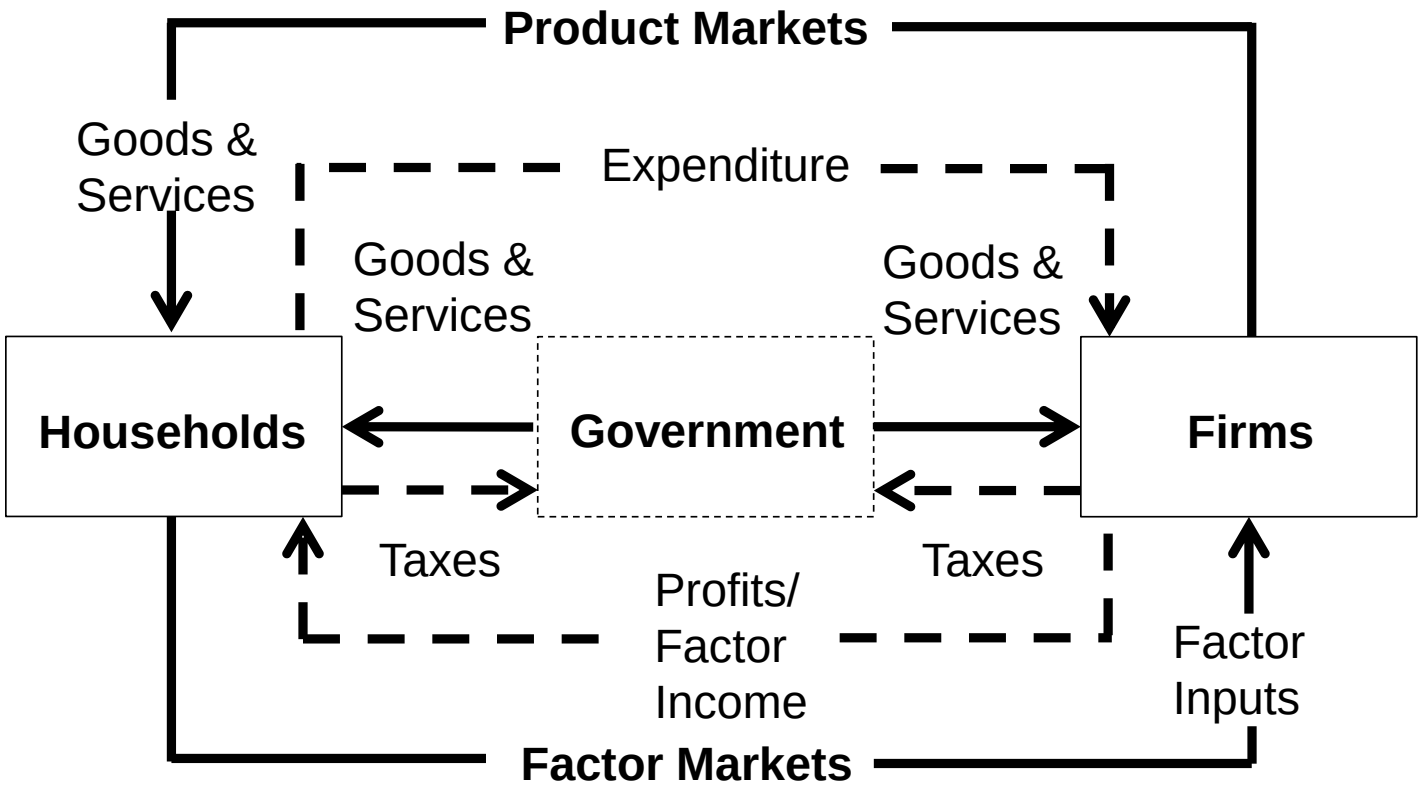
# Input-output models can be expanded to include more rigor by incorporating the components associated with CGE models




- The blue boxes represent a typical Input-Output model with limited variable interaction

- The white boxes represent a typical CGE model, combining input-output responses with several additional components. This increases accuracy and allows the user to manipulate many more variables and measure impacts over time

The fundamental conceptual starting point for a macroeconomic model is the circular **flow of commodities** in a closed economy

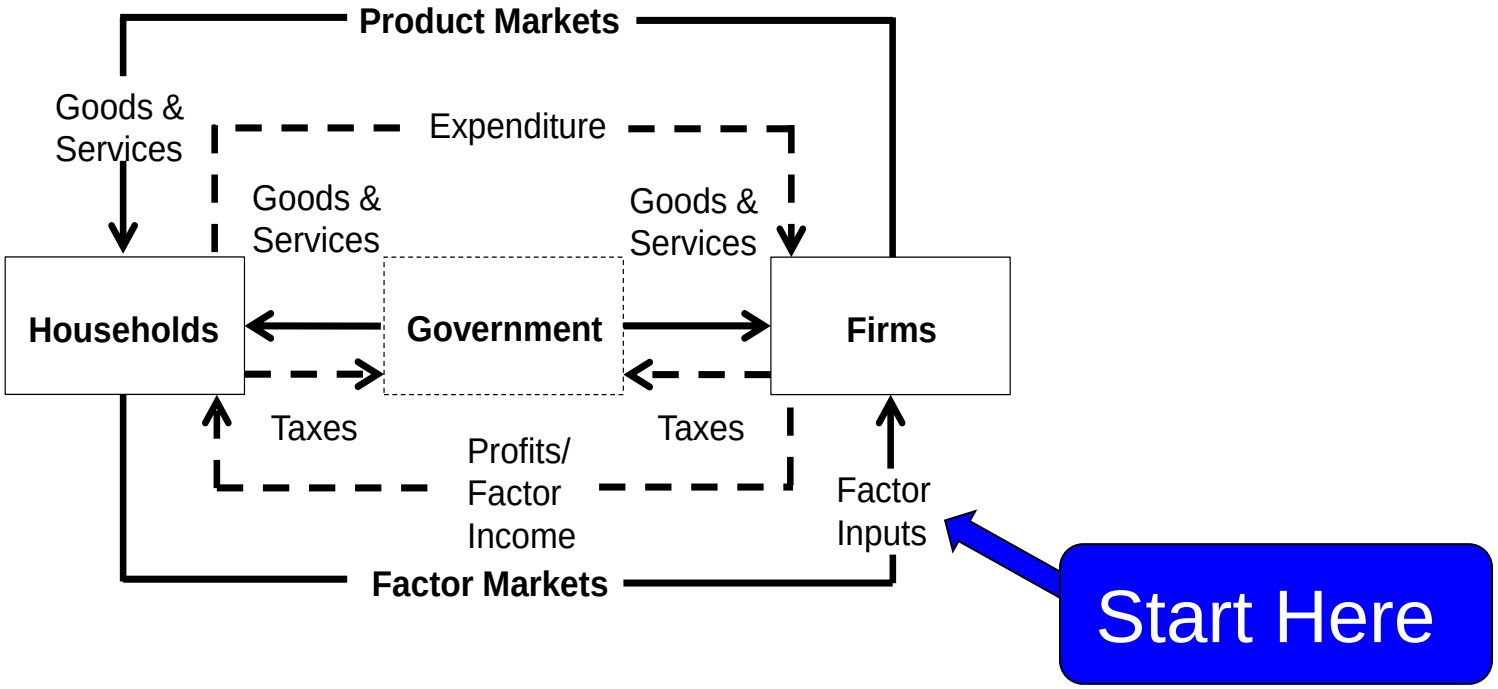


# Actors in a dynamic macroeconomic model circular flow

- The main actors in the diagram are households and firms
  - **Households:** Own the factors of production and are the final consumers of produced commodities
  - **Firms:** Rent the factors of production from the households for the purpose of producing goods and services that the households then consume
- Many dynamic macroeconomic models also explicitly represent the government
  - **Government:** Role in the circular flow is often passive: to collect taxes and disburse these revenues to firms and households as subsidies and lump-sum transfers, subject to rules of budgetary balance that are specified by the analyst

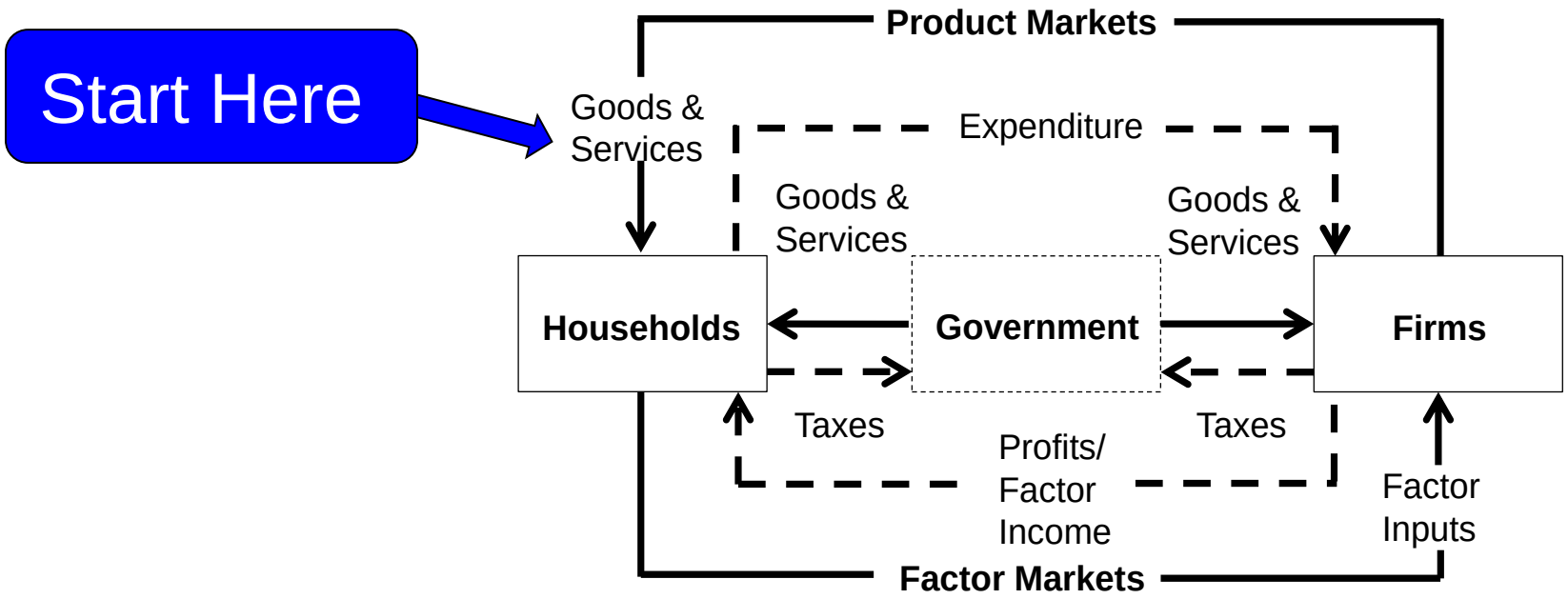
# Tracing the circular flow

- Start with the supply of factor inputs (e.g., labor and capital services) to the firms and continue to the supply of goods and services from the firms to the households, who in turn control the supply of factor services ("circular flow")



# Tracing the circular flow

- Or…... begin with “payments” to households for their services (labor) and to investors for capital, used to produce the goods and services, which is considered “income” and used to pay for goods and services they consume (“circular flow”)



# After the break you will have an opportunity to use a macroeconomic software as you analyze two sample case studies

- Using a software based model, we are able to take advantage of the computational power of a dynamic macroeconomic model
- As this comes on a CD it is easily transportable and allows for analyses anywhere in the world via a common laptop

**30 minute break**

**Participants should load the software!**

# Class Exercise 1: Using a Dynamic Macroeconomic Model

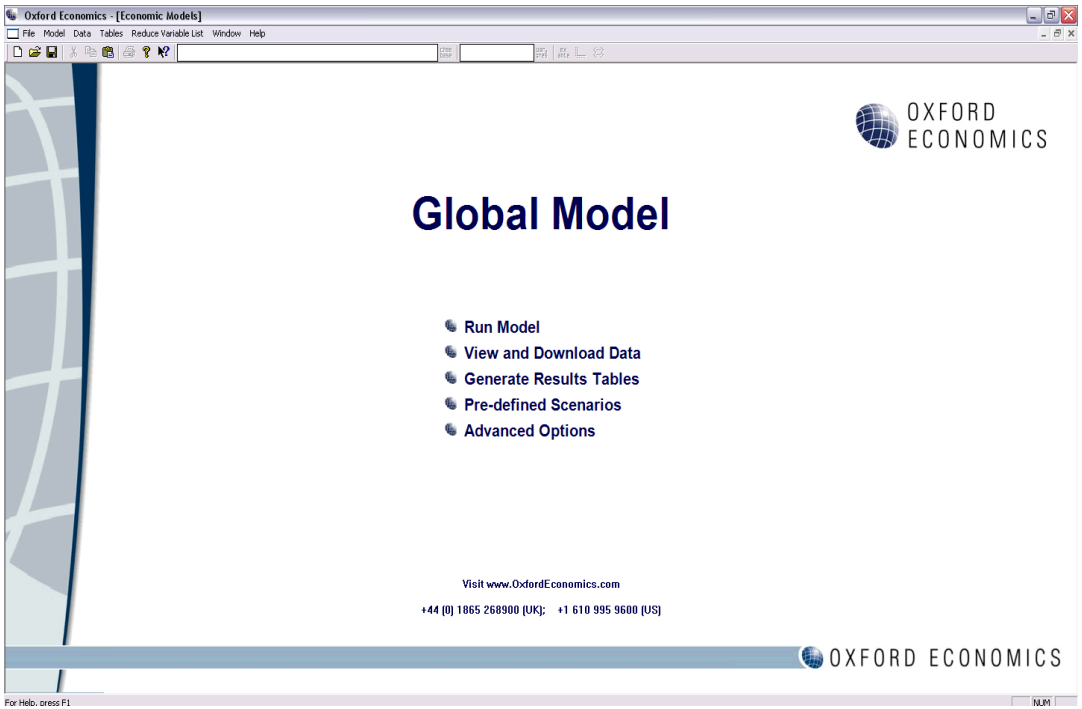
# Class Exercise 1: background and assumptions

- For this Analysis we will be using a demo of the Oxford Economics Global Model to measure the economic impacts of a regulation in the country of **Switzerland**

- **Regulation:** The Ministry of Finance passed a regulation to increase the Value Added Tax (VAT) from 6.87% to 13% (similar example to previous one discussed but data pertinent to Switzerland)

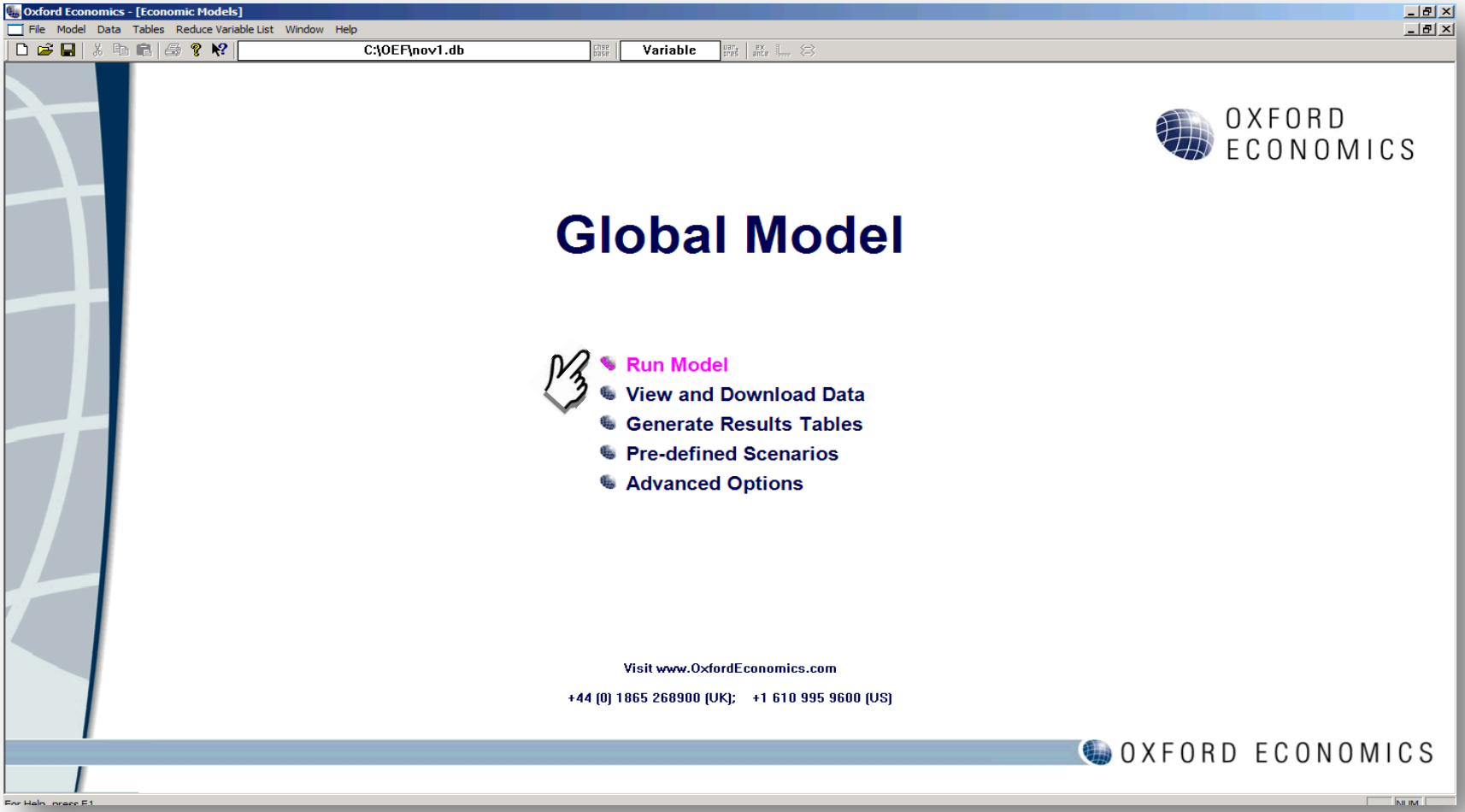
# The first screen is the menu screen and displays 4 activity options

- **Run Model**
  - Provides access to the model and allows the user to examine individual series graphically and numerically
  - Allows the user to change the forecast path
- **View and Download Data**
  - Provides access to view and compare data from different countries and different databases
  - Allows for export of data into Excel
- **Generate Results Tables**
  - Produces a number of standard tables from the Model databases
- **Pre-Defined Scenarios**
  - We can implement a number of standard changes or “shocks” to the baseline to perform a scenario analysis

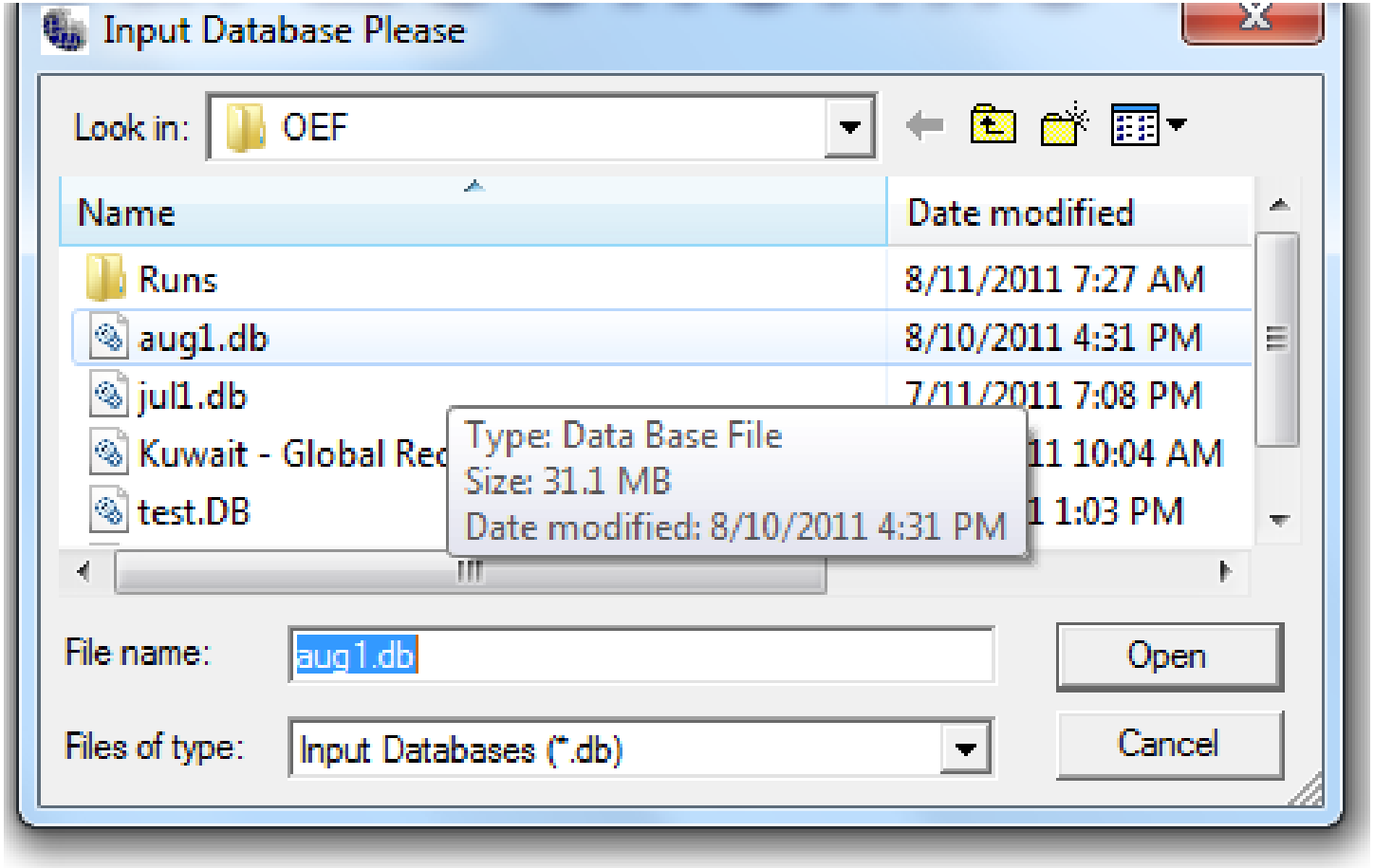



**FIRST SCREEN**

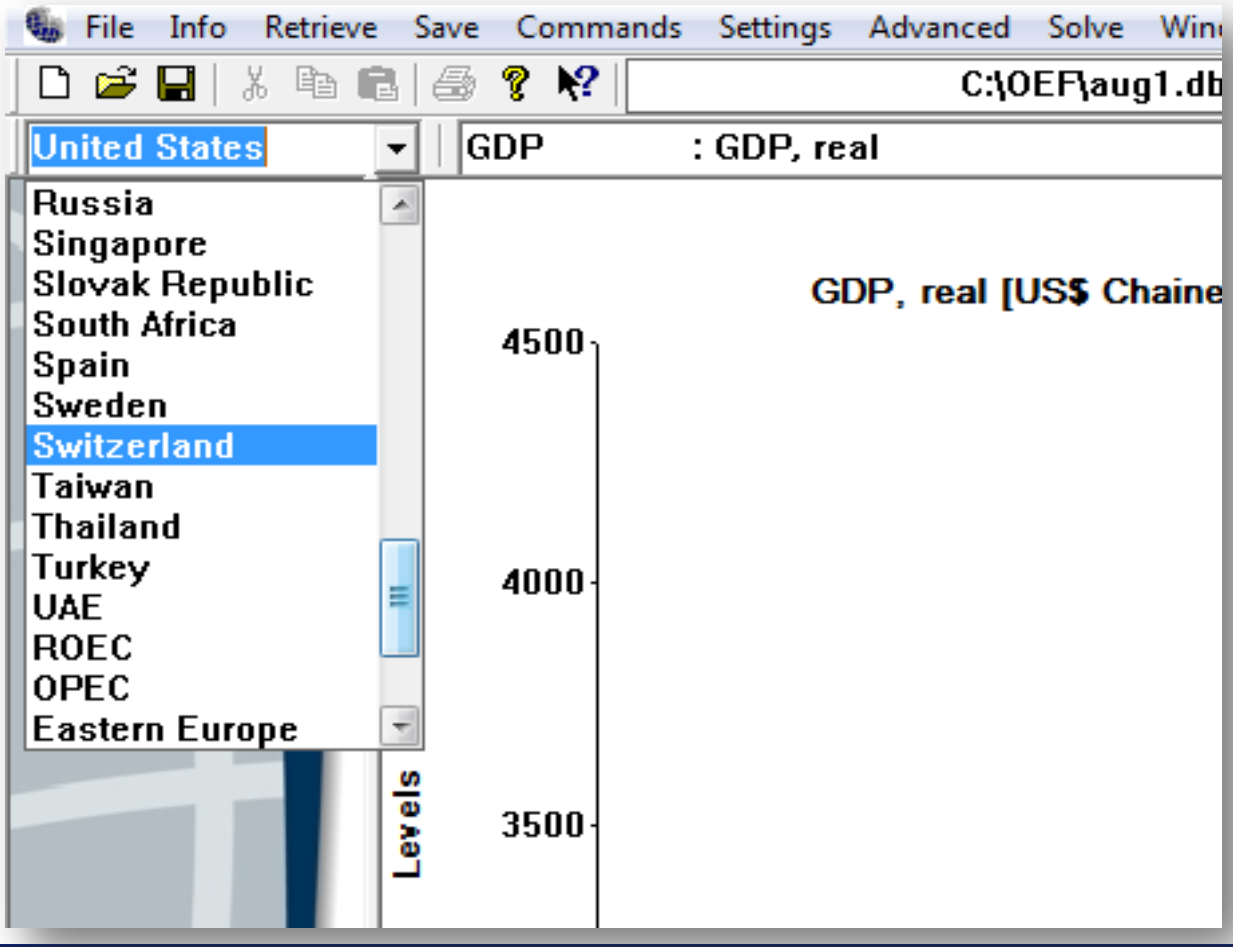
# We begin with “Run Model” command for our exercise



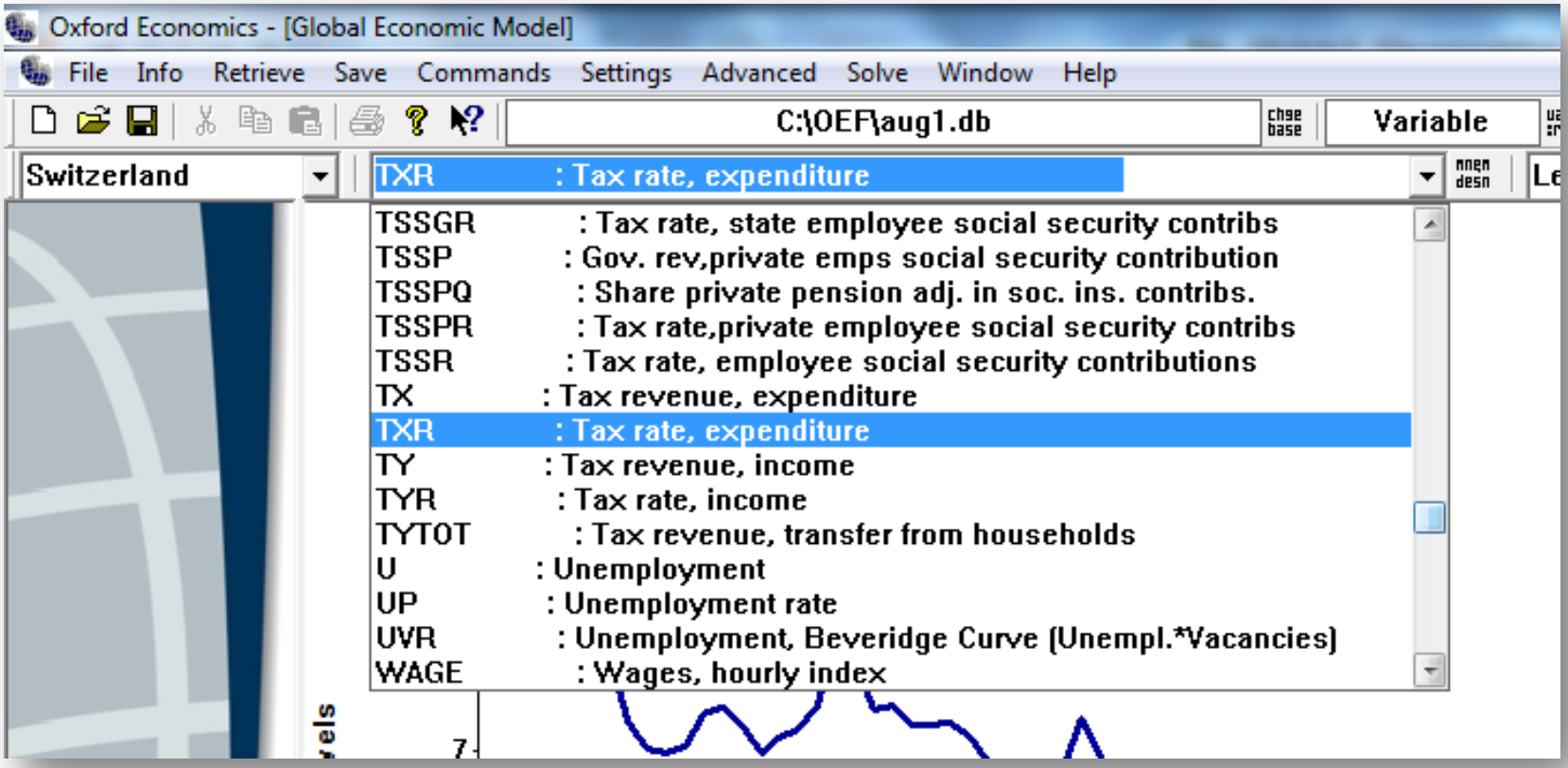
# Select the database “aug.db” for this exercise



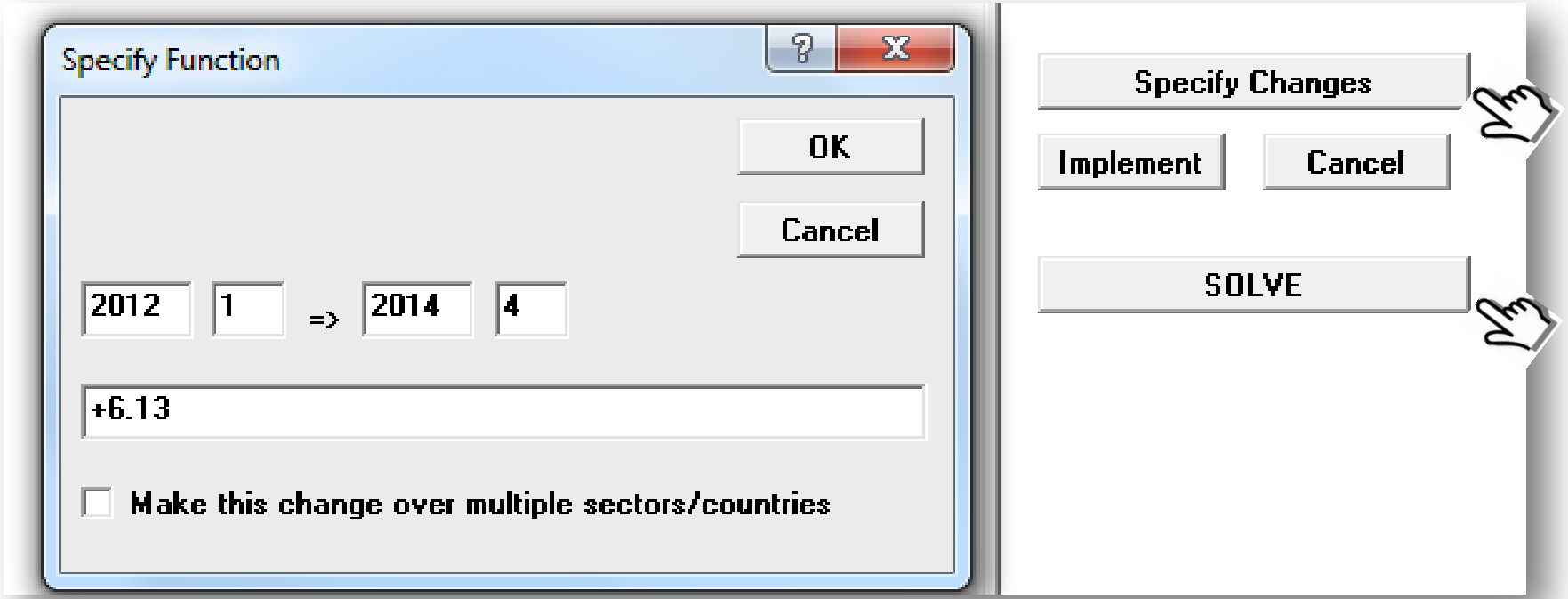
# Using the drop down menu in the top left corner of your Oxford Economics menu select the country of Switzerland



# Using the drop down menu in the center of your screen select the tax rate expenditure variable (TXR)

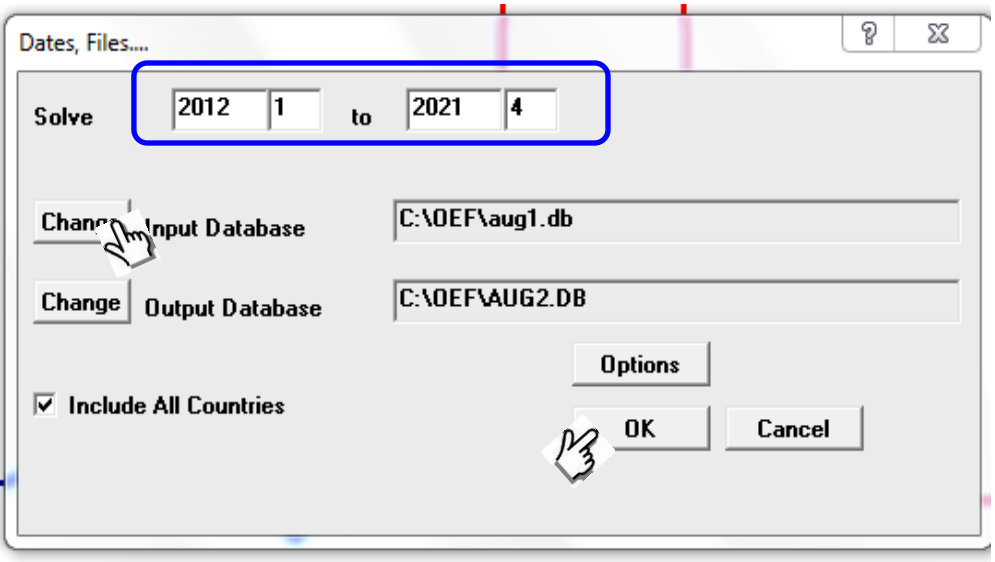


- In the top right-hand corner of your screen click on the “Specify Changes” button
- A screen will come up titled “Specify Function” as seen below
- In the empty bar below the years, type “+6.13” and hit “Solve”

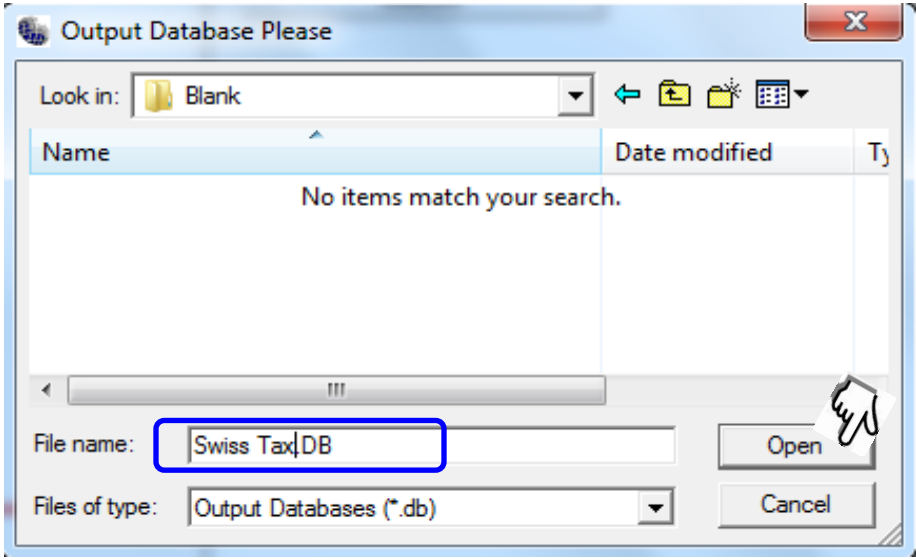


- Screen 1 will pop up titled “Dates, Files”. For the dates type in 2012 ,1 to 2021, 4;
- Screen 1: Press the lower of two “Change” buttons. The 2nd screen will pop up.
- Screen 2: Rename the output database “Swiss Tax.DB”;
- Screen 2: Press Open
- Screen 1: Press OK

**Screen 1**

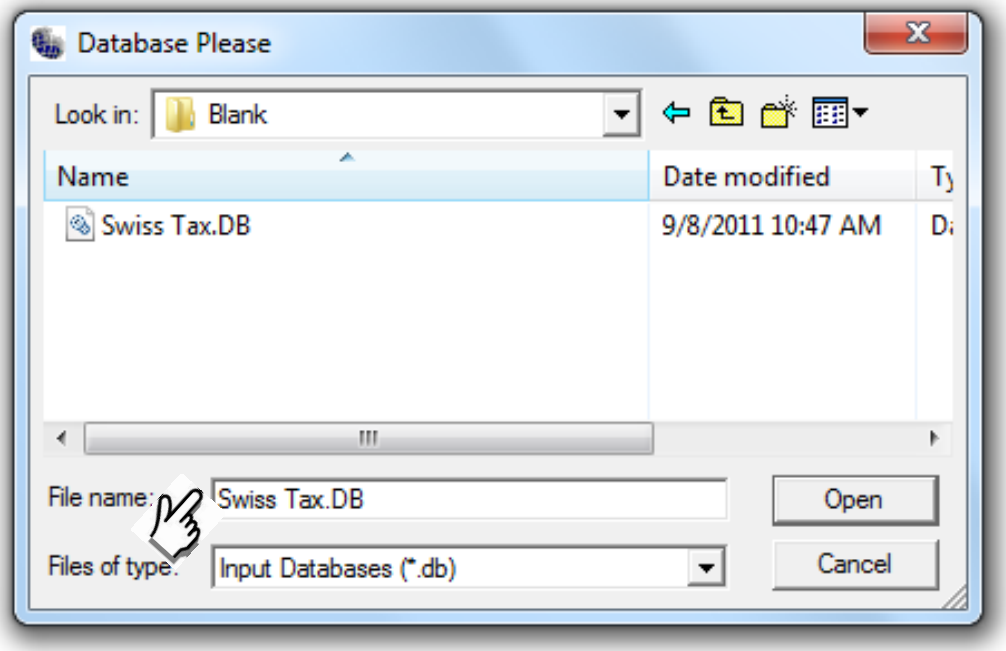



**Screen 2**

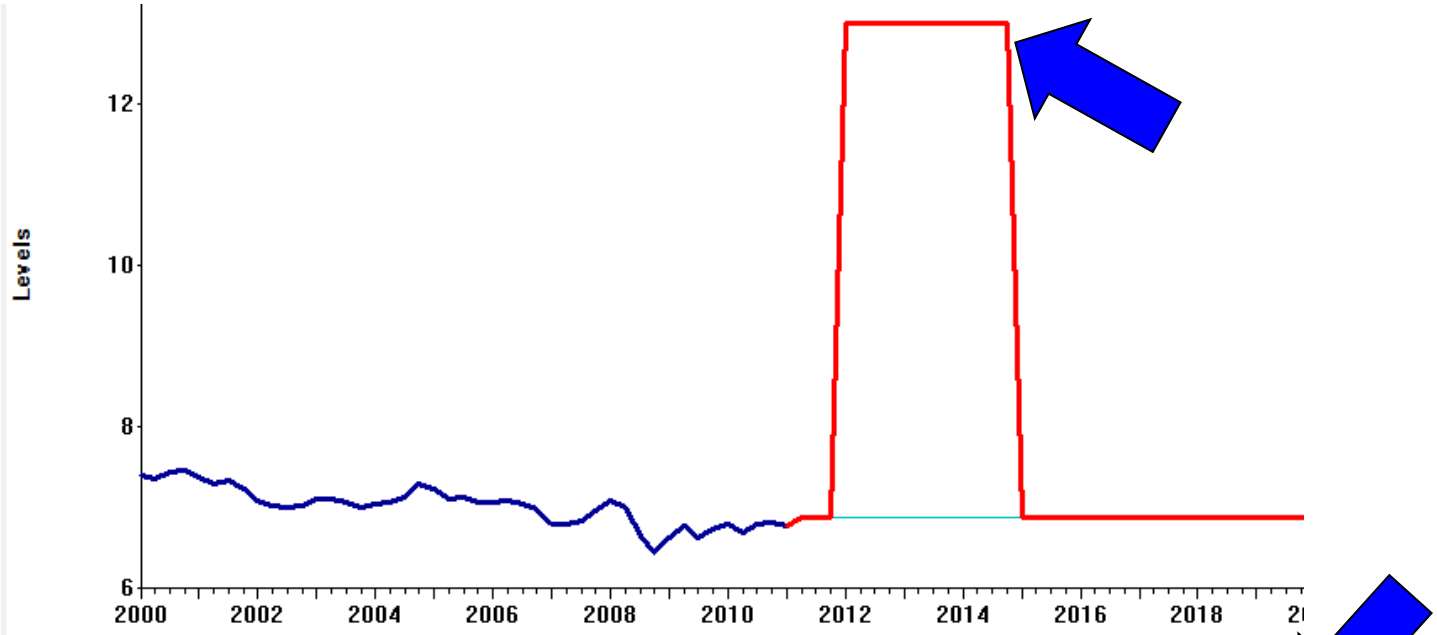


# Screen will pop up titled "Database Please". Select the "Swiss Tax. DB" and click "0pen"

- Run Model
- View and Download Data
- Generate Results Tables
- Pre-defined Scenarios
- Advanced Options

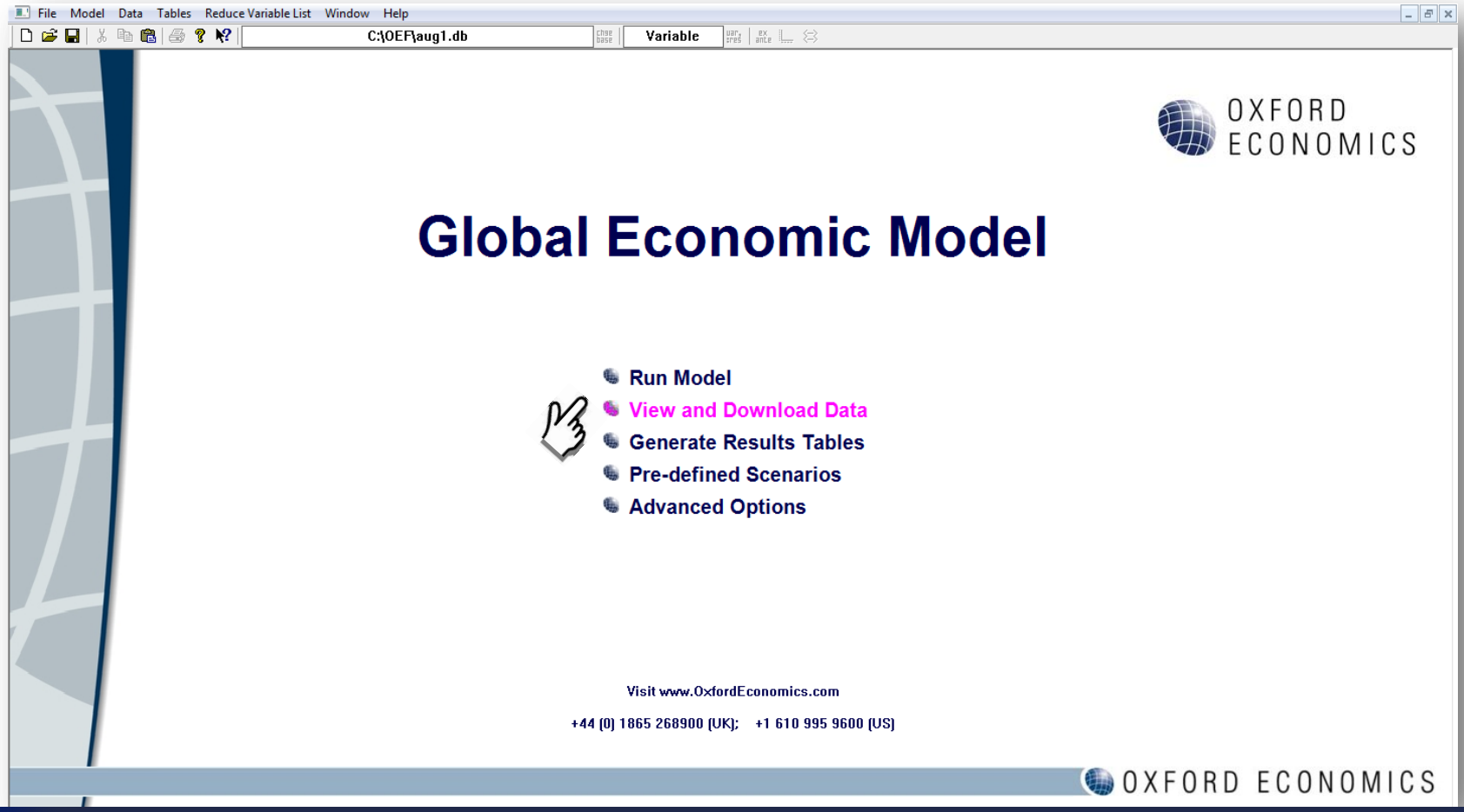


# The result will show an increase in the projected tax rate on expenditures from 6.87% to 13%, as seen in the representative line and table below

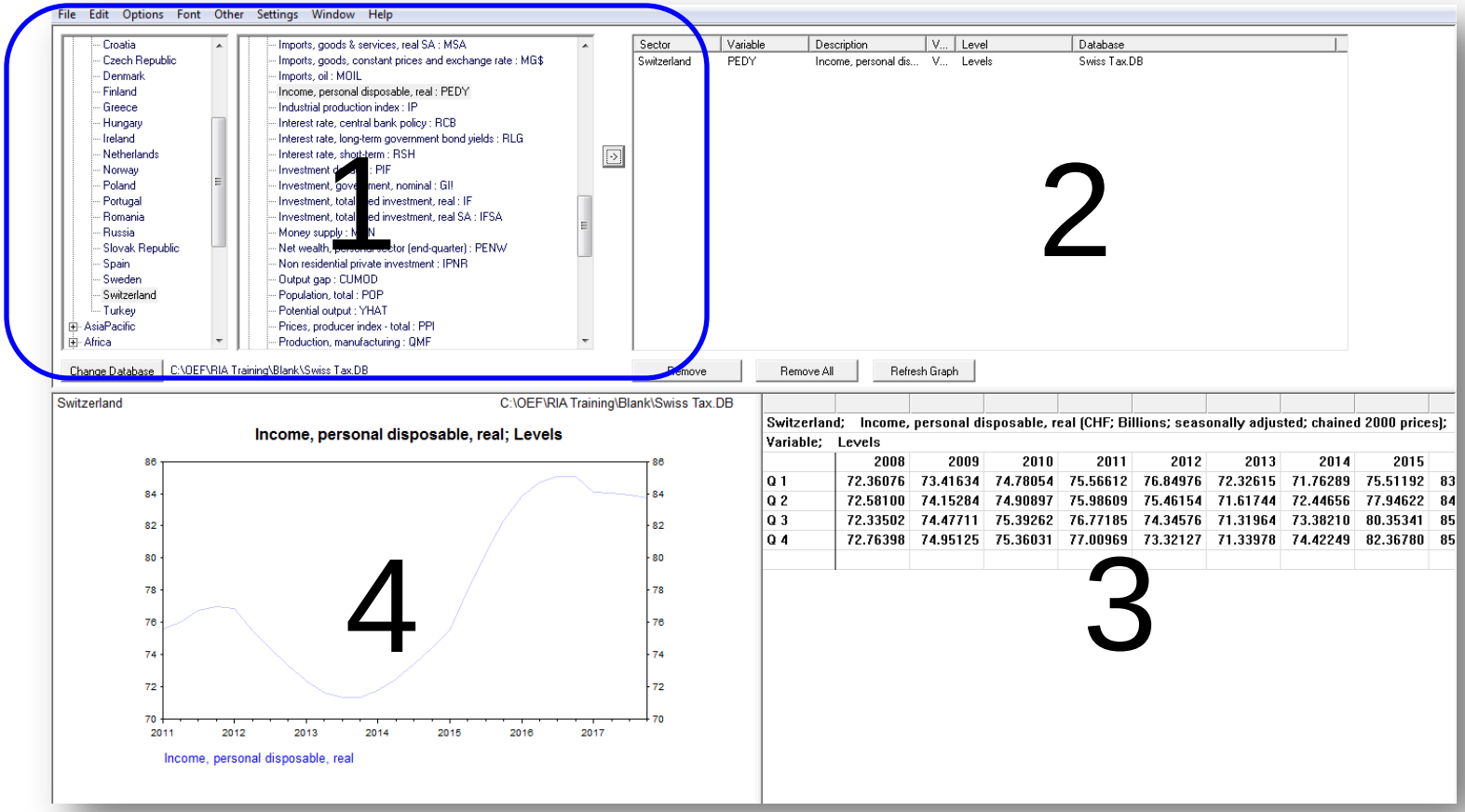



| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q 1 | 7.064410 | 6.783470 | 7.076930 | 6.611970 | 6.776690 | 6.755290 | 13.00000 | 13.00000 | 13.00000 | 6 |
| Q 2 | 7.068120 | 6.777220 | 6.982850 | 6.763480 | 6.686210 | 6.870000 | 13.00000 | 13.00000 | 13.00000 | 6 |
| Q 3 | 7.034170 | 6.834060 | 6.633630 | 6.610730 | 6.783720 | 6.870000 | 13.00000 | 13.00000 | 13.00000 | 6 |
| Q 4 | 6.977710 | 6.947120 | 6.421340 | 6.716460 | 6.806380 | 6.870000 | 13.00000 | 13.00000 | 13.00000 | 6 |

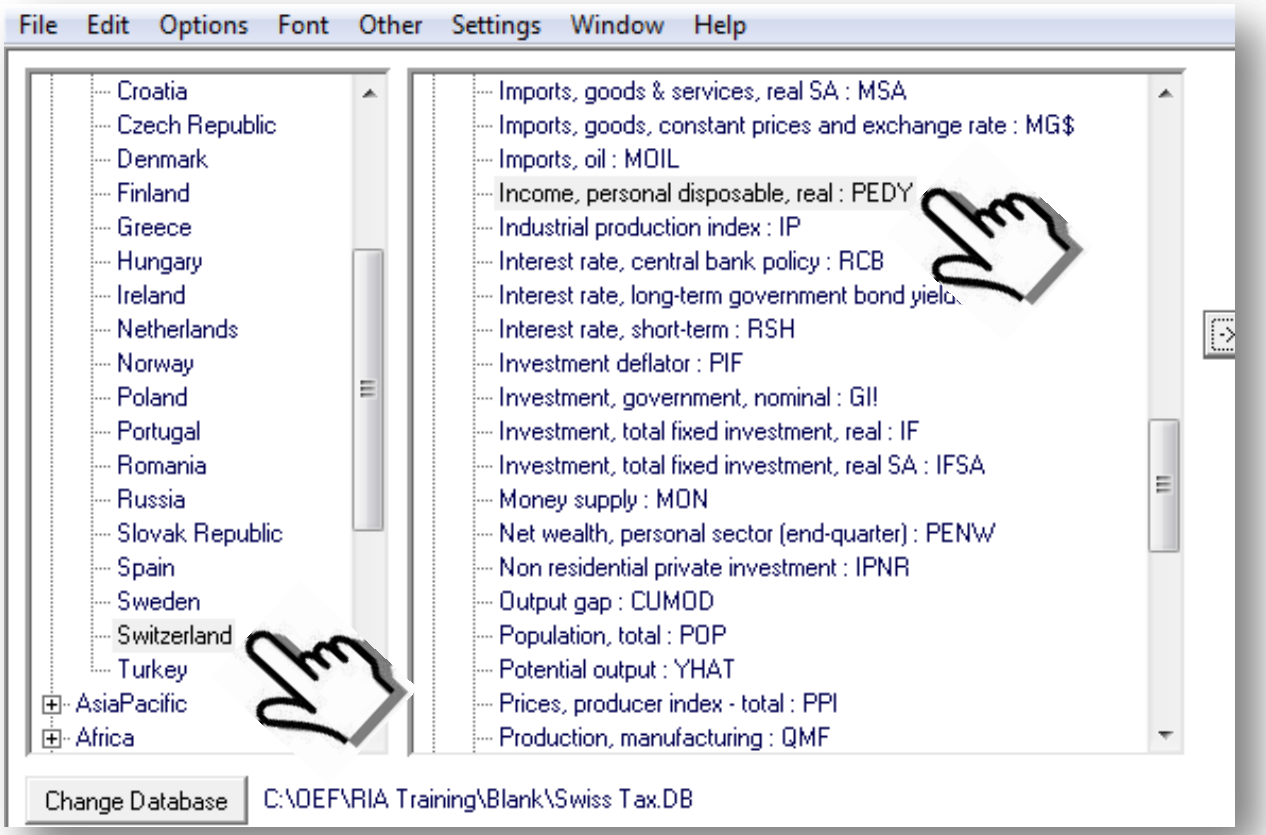
# To see the impact on other variables in the Swiss and global macro-economies select “View and Download Data” from your main screen



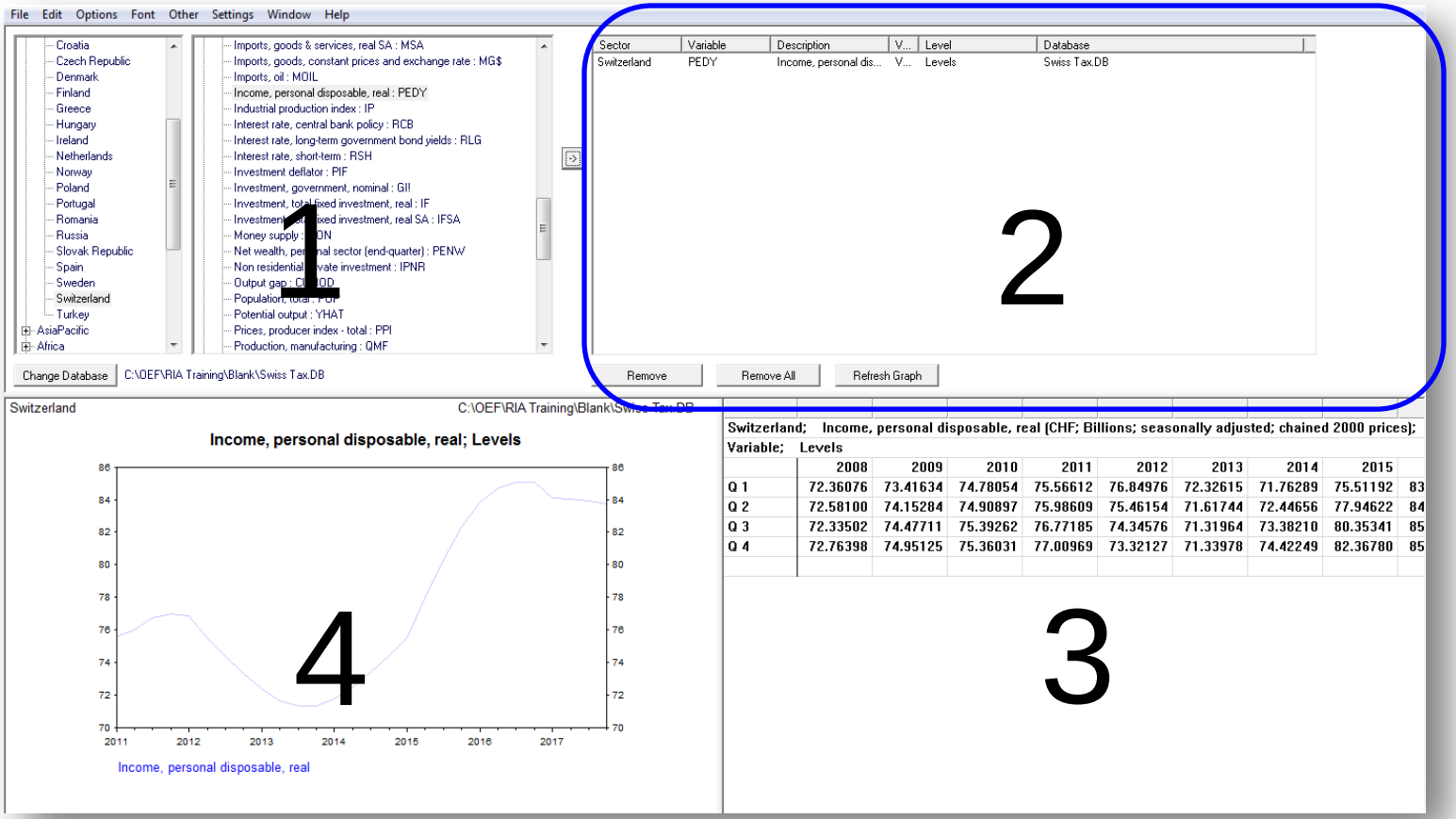
- **Screen below will pop up, allowing us to select specific variables to measure the impact of an increase in expenditure tax rates**
- **To select variables, we will initially focus on Quadrant 1**



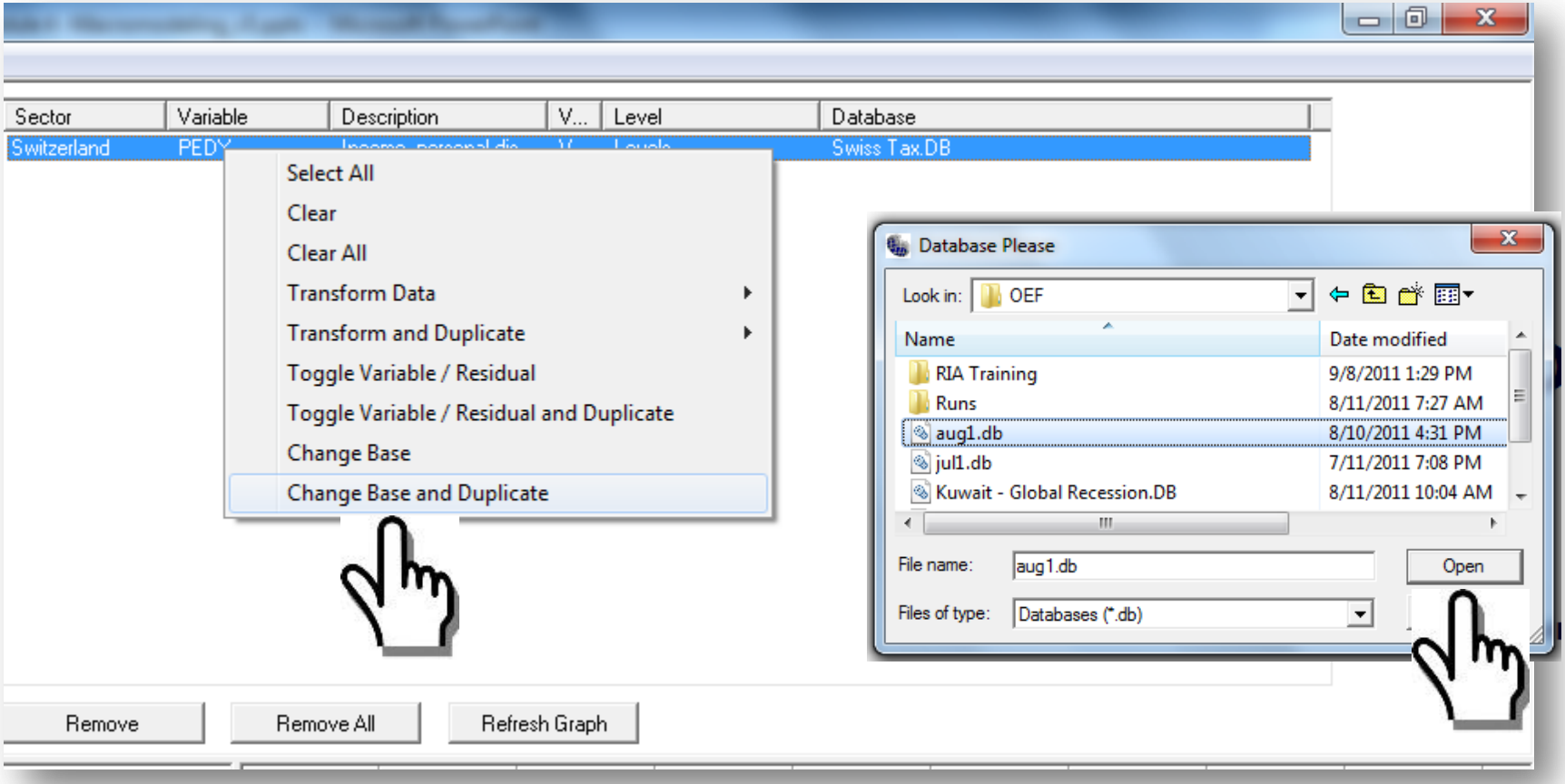
- From the country list select "Switzerland"
- From the variable list, under "Key Indicators" select "Income, Personal Disposable, real: PEDY"



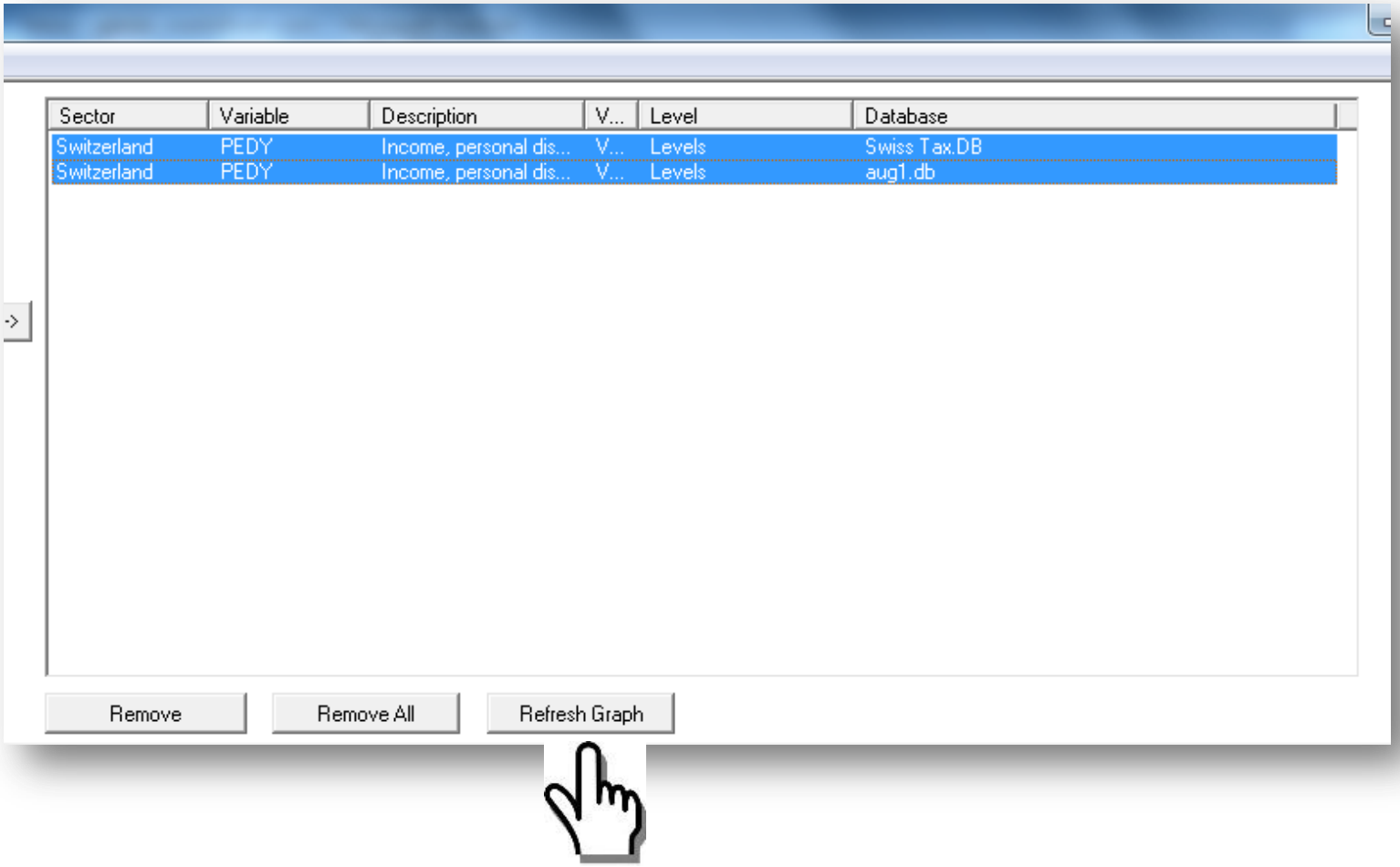
# We will now focus on quadrant 2 of the screen



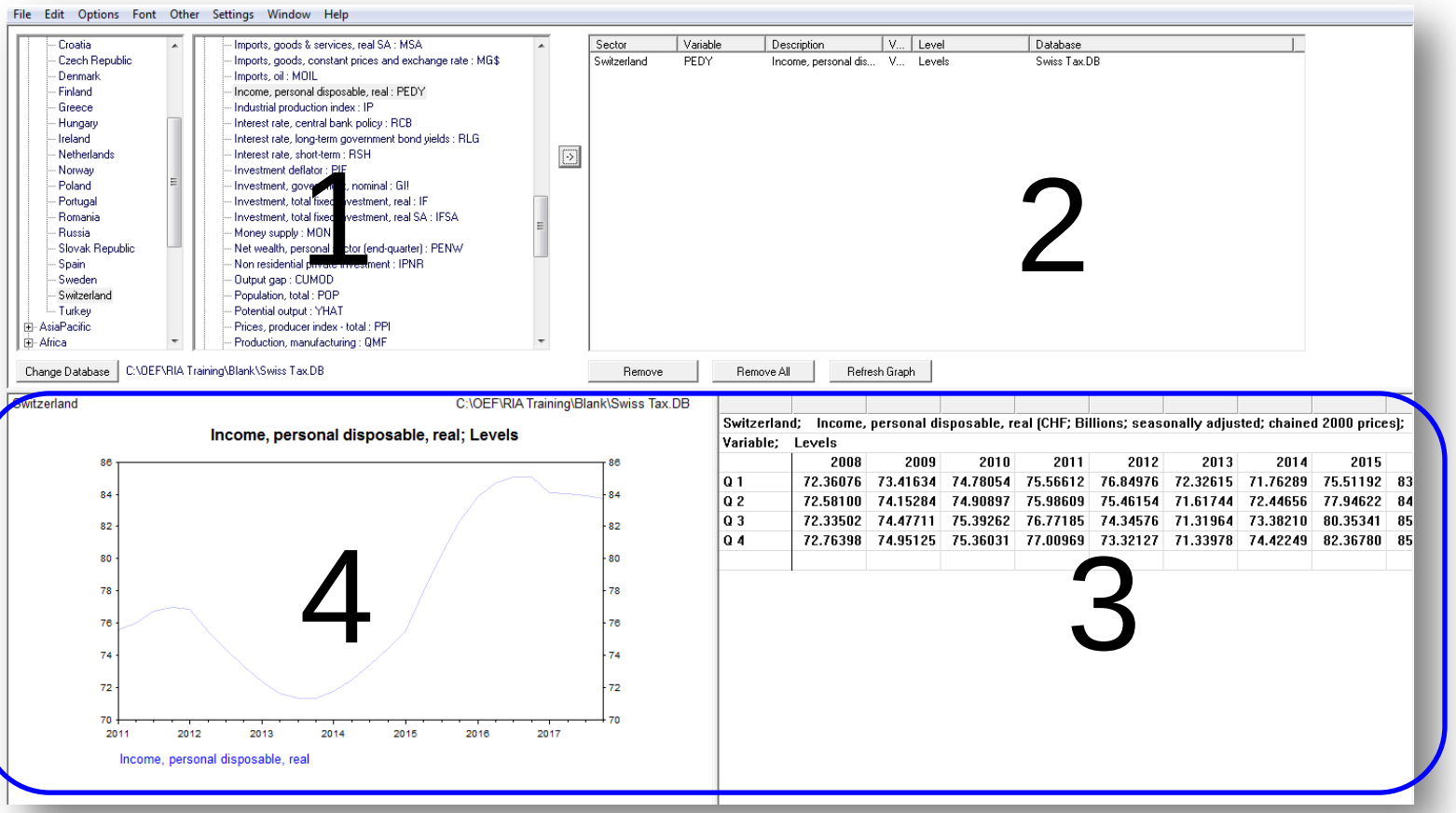
- Variable PEDY will already be selected for the "Swiss Tax" database
- To measure the impact of the VAT regulation, RIGHT CLICK on the variable and select "Change Base and Duplicate"
- Selection screen will appear – select "aug1.db" and click open



# Select both database options and click on “Refresh Graph”



# To quantify and see graphically the economic impact of the VAT regulation change, we will focus on Quadrants 3 and 4 of this screen



# Quadrant 3: Resulting from an increase in Switzerland's VAT from 6.9-13%, total real PDI is projected to decrease by approx. 72B (SF), or an annual average of approx. 18B (SF) between 2012 and 2015 (FY 2000 SF)

Database with VAT tax Increase

Switzerland; Income, personal disposable, real (CHF; Billions; seasonally adjusted; chained 2000 prices); C:\OEF\RIA Training\Blank\Swiss Tax.DB
Variable; Levels

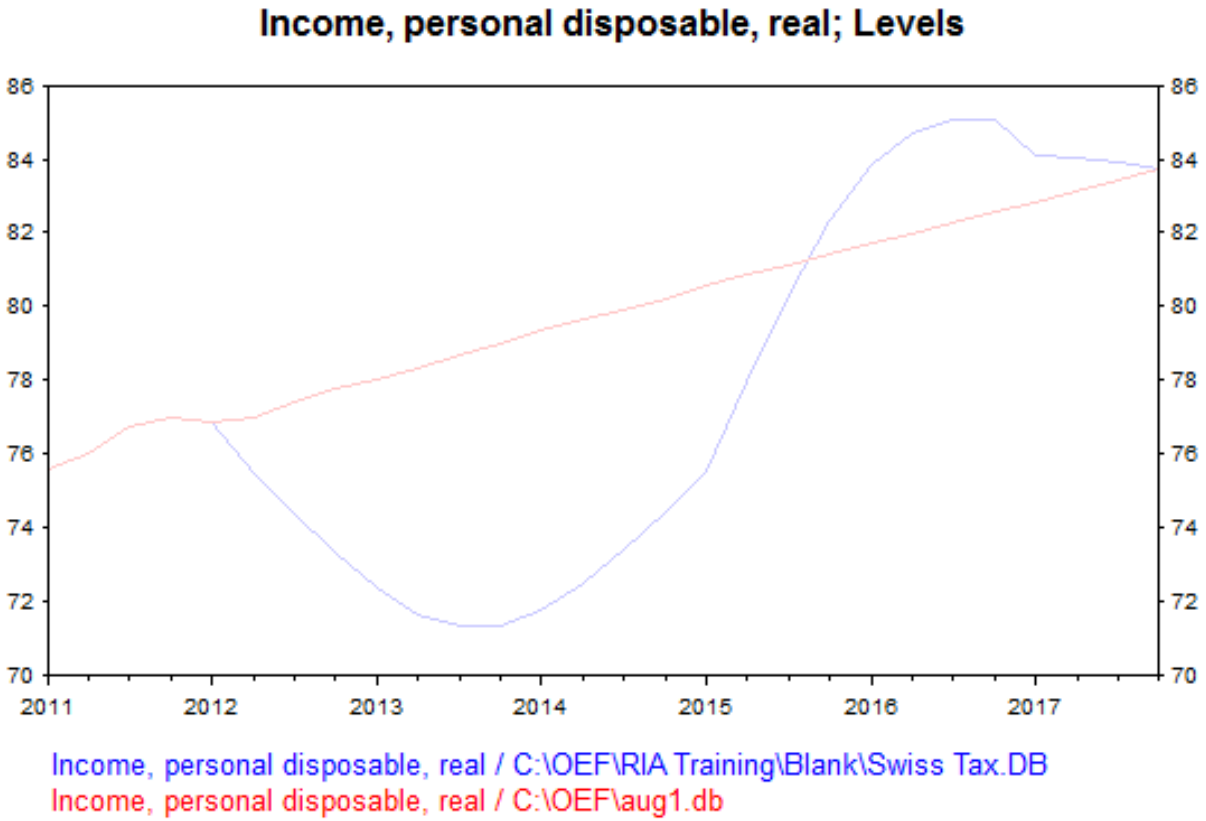
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q 1 | 73.41634 | 74.78054 | 75.56612 | 76.84976 | 72.32615 | 71.76289 | 75.51192 | 83.88846 | 84.12910 | 83.68901 | 84.31882 | 86.29343 | 87.78484 |
| Q 2 | 74.15284 | 74.90897 | 75.98609 | 75.46154 | 71.61744 | 72.44656 | 77.94622 | 84.77328 | 84.05324 | 83.66805 | 84.74709 | 86.77089 | 88.00513 |
| Q 3 | 74.47711 | 75.39262 | 76.77185 | 74.34576 | 71.31964 | 73.38210 | 80.35341 | 85.11148 | 83.93991 | 83.76314 | 85.25344 | 87.19604 | 88.17793 |
| Q 4 | 74.95125 | 75.36031 | 77.00969 | 73.32127 | 71.33978 | 74.42249 | 82.36780 | 85.13501 | 83.79749 | 83.98096 | 85.77051 | 87.55131 | 88.32706 |

Baseline

Switzerland; Income, personal disposable, real (CHF; Billions; seasonally adjusted; chained 2000 prices); C:\OEF\aug1.db
Variable; Levels

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q 1 | 73.41634 | 74.78054 | 75.56612 | 76.84972 | 78.04854 | 79.38665 | 80.59933 | 81.74065 | 82.88449 | 84.03109 | 85.16866 | 86.30732 | 87.46420 |
| Q 2 | 74.15284 | 74.90897 | 75.98609 | 76.97443 | 78.34647 | 79.66852 | 80.87467 | 82.02593 | 83.17113 | 84.31461 | 85.45261 | 86.59103 | 87.74969 |
| Q 3 | 74.47711 | 75.39262 | 76.77180 | 77.42574 | 78.69431 | 79.95008 | 81.15108 | 82.31271 | 83.45920 | 84.59897 | 85.73782 | 86.87579 | 88.03604 |
| Q 4 | 74.95125 | 75.36031 | 77.00975 | 77.80386 | 79.01290 | 80.23280 | 81.42876 | 82.60037 | 83.74834 | 84.88504 | 86.02432 | 87.16187 | 88.32333 |

# Quadrant 4: Resulting from an increase in Switzerland's VAT from 6.9-13%, total real PDI is projected to decrease by approx. 72B (SF), or an annual average of approx. 18B (SF) between 2012 and 2015 (FY 2000 SF)



# Discussion and Questions

# Class Exercise 2
# Using a Macroeconomic Model

# Class Exercise 2: Assumptions

- The Turkish Customs Administration in coordination with the Ministry of Finance issued a regulation to establish requirements for all goods imported into Turkey
- This regulation specifically states that imported goods must be adequately priced to reflect the costs associated with importing and registering these goods in Turkey
- Once on the market the cost of these goods should reflect:
  - The cost of transport of the imported goods to Turkey
  - Loading, unloading and handling charges associated with the transport of the imported goods to Turkey
  - The cost of insurance
  - Commissions and brokerage, except buying commissions
  - The cost of containers, which are treated as being one for customs purposes with the goods in question
  - The cost of packing whether for labor or materials

# Group Exercise (Tasks 1-3 ) - 30 minutes

## Break into groups

**Task 1**: Within your groups **identify and list** the economic factors that you foresee being impacted as a result of the customs regulation

*e.g., Domestic prices for certain goods imported into Turkey will increase*

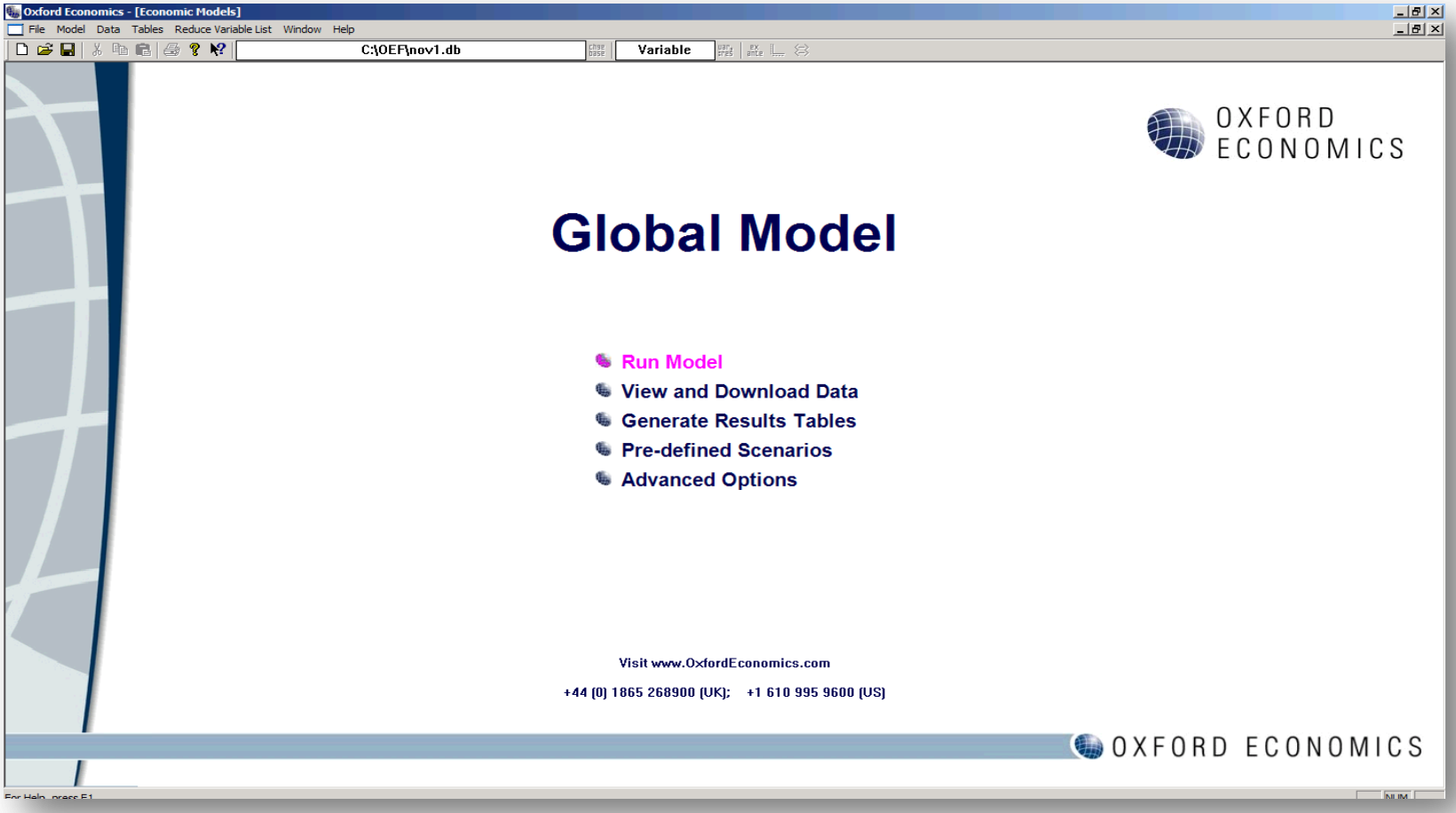
**Task 2:** From this list come to an agreement on **the top three economic factors** that you foresee being impacted as a result of the customs regulation -

*e.g., Domestic consumption of imported goods will decrease*

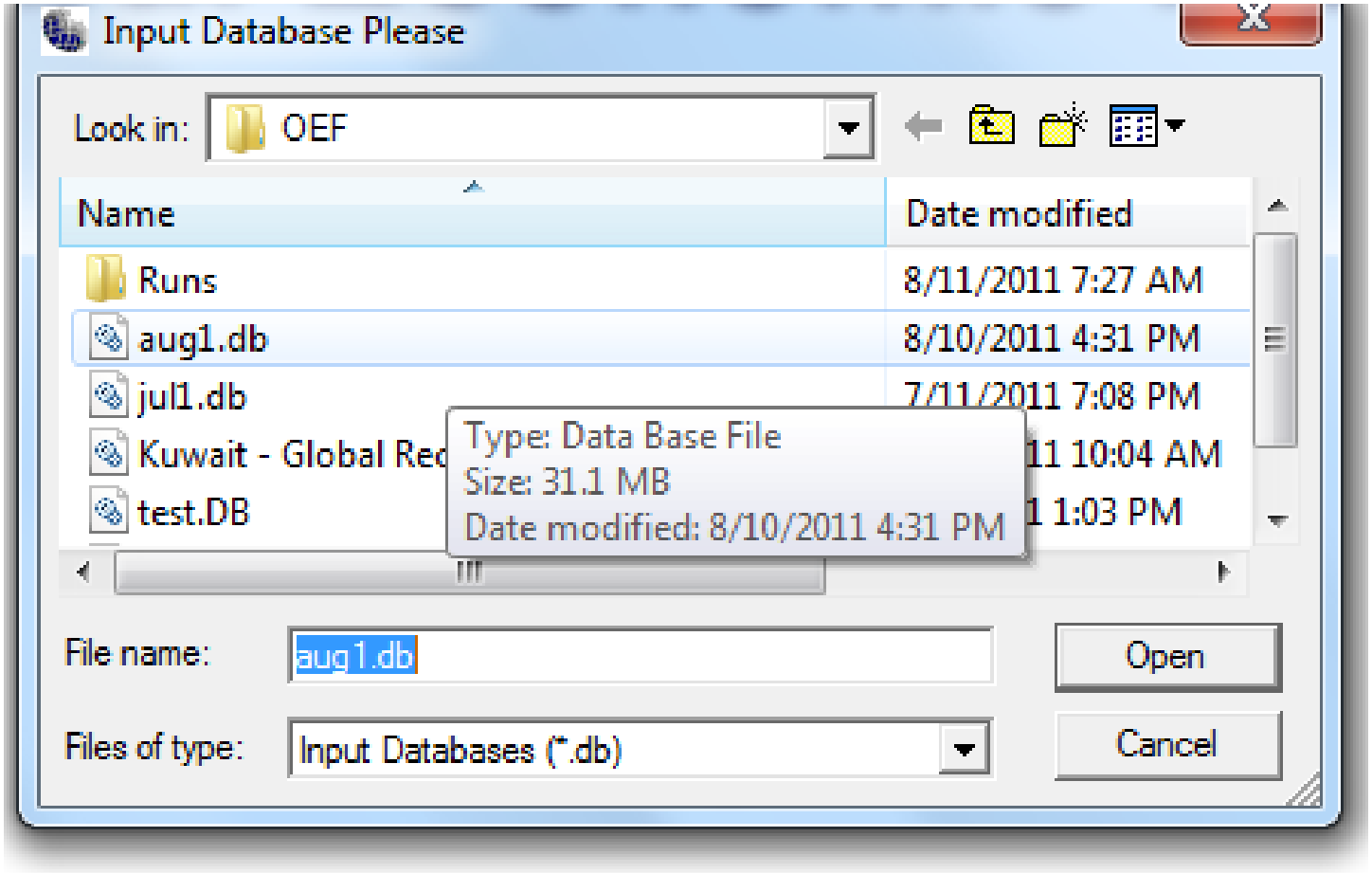
**Task 3:** Provide an explanation and be ready to present***: "Why each of the three factors will be impacted directly by the customs regulation?"***

- **Group Exercise – (Task 4) - 15 minutes**

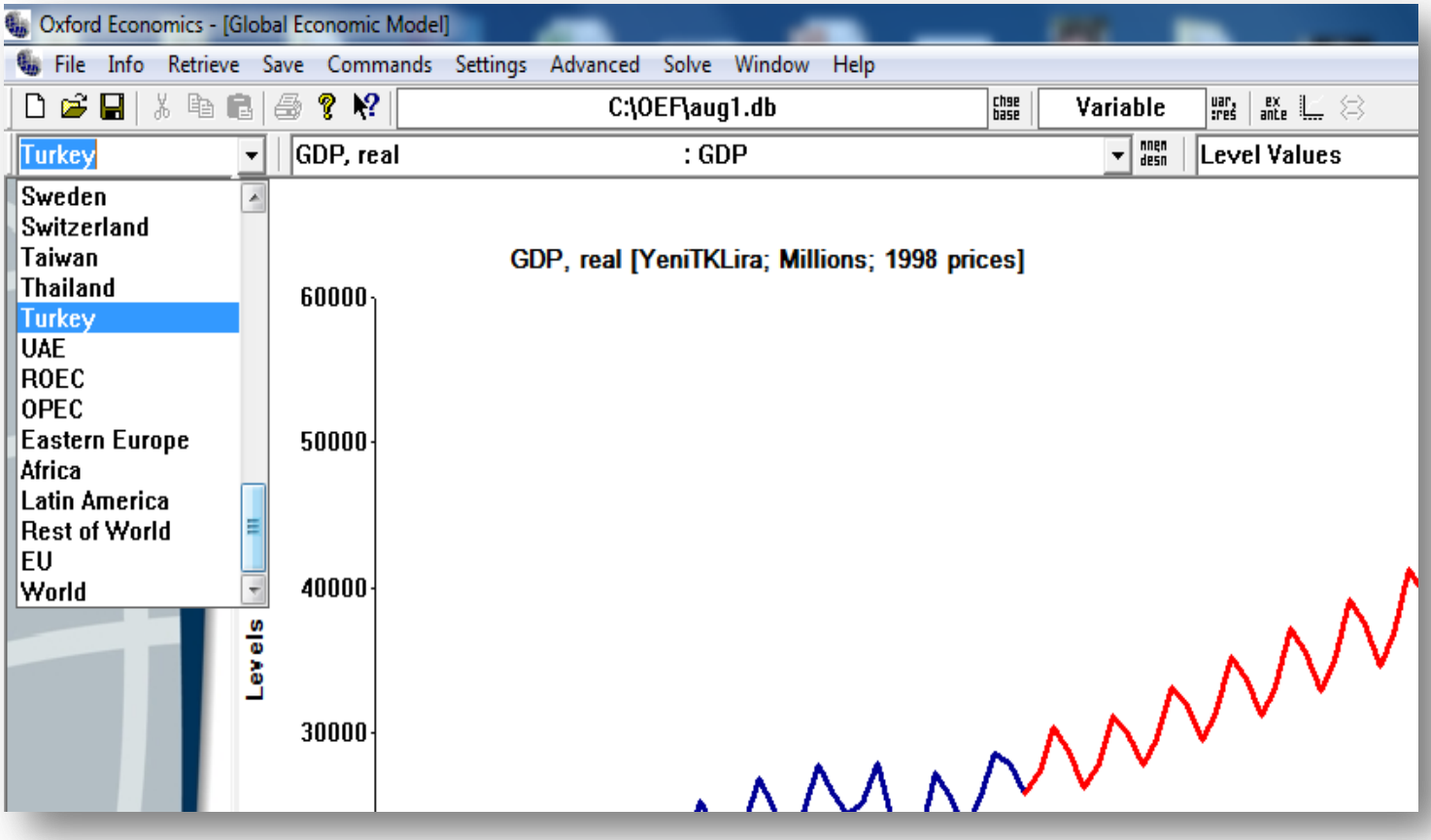
- **Again, we begin with the "Run Model" command**



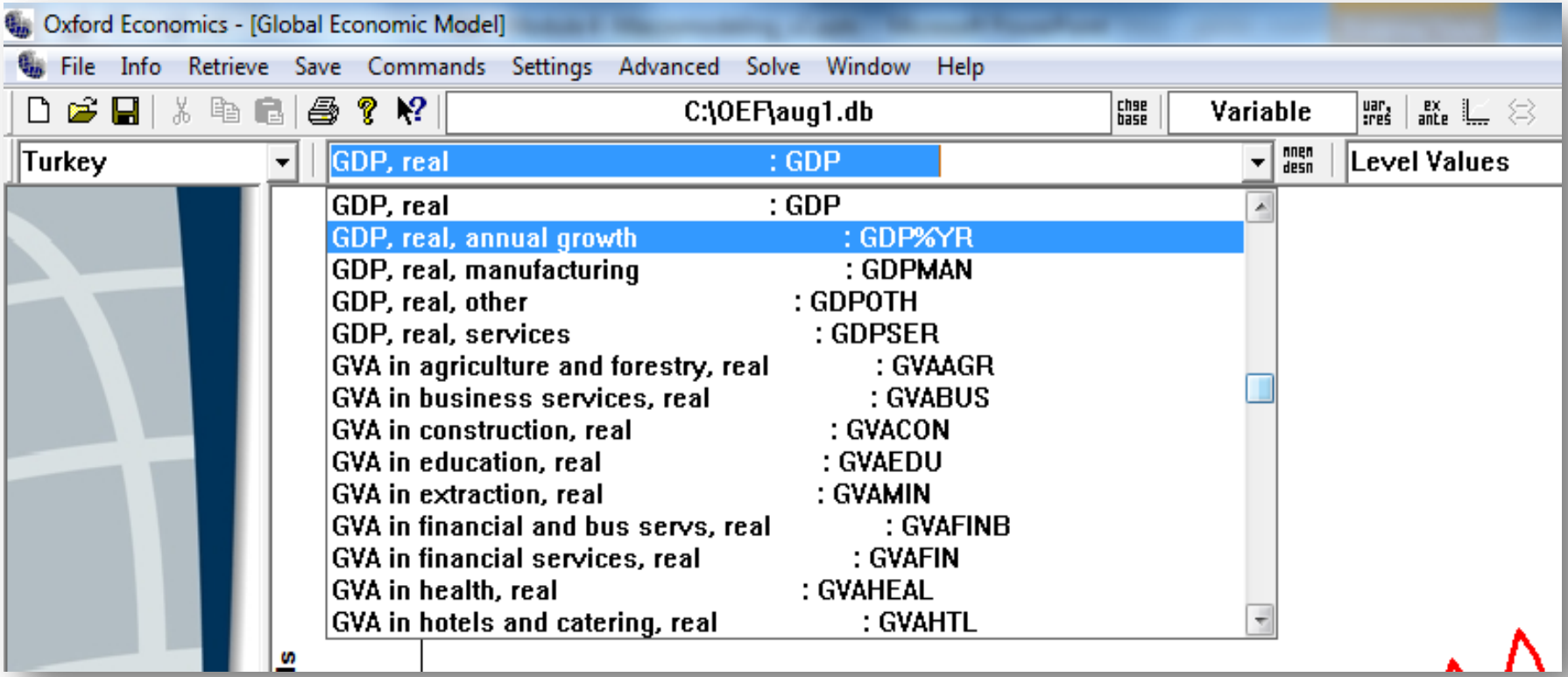
# Select aug1.db for this exercise



# Using the drop down menu in the top left corner of your Oxford Economics menu select the country of Turkey



- Match the variables that you have identified to the Turkish OEM model variable list as seen below
- In instances where variables do not match identify options from the variable list that could be used as substitutes to represent the change associated with the regulation



# Discussion and Questions

## As part of this module you…

- Learned how dynamic macroeconomic models can supplement input - output models as part of a cost / benefit analysis framework
- Learned about alternative types and the components that make up dynamic macroeconomic models and why this makes them useful for regulatory assessments
- Gained experience operating dynamic macroeconomic models using a dynamic macroeconomic modeling software as you worked through two case studies

## Tomorrow: what to do with what you have learned!

- How to communicate your RIA findings in effective ways
- A real-world example of an effective RIA
- How stakeholder analysis and business associations can make a difference